PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-261449
(43)Date of publication of application : 13.09.2002

(51)Int.Cl. H05K 3/46
H01L 23/12
H01L 23/14
H01L 25/04
H01L 25/18
H05K 1/11
H05K 1/18
H05K 3/40

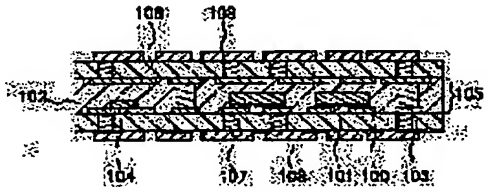
(21)Application number : 2001-379696
(22)Date of filing : 13.12.2001

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : NAKATANI SEIICHI
SUGAYA YASUHIRO
ASAHI TOSHIYUKI
KOMATSU SHINGO

(30)Priority
Priority number : 2000397728 Priority date : 27.12.2000 Priority country : JP

(54) MODULE WITH BUILT-IN COMPONENT AND ITS MANUFACTURING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a module with built-in component in which an inorganic filler can be applied at a high concentration, active components, such as the semiconductor or passive components, such as the chip resistor and chip capacitor can be embedded by a simple method, and a multilayer wiring structure can be produced easily.
SOLUTION: The module with the built-in component has a core layer made of an electrical insulating material and an electrical insulating layer and a plurality of wiring patterns formed on at least one surface of the core layer. The electrical insulating material of the core layer is composed of a mixture containing at least the inorganic filler and a thermosetting resin. The core layer incorporates at least one or more active component and/or passive components and has a plurality of wiring patterns and inner vias composed of a conductive resin. In addition, the elastic modulus of the electrical insulating material of the core layer composed of the mixture containing at least the inorganic filler and thermosetting resin at a room temperature is adjusted within the range of 0.6-10 GPa.



LEGAL STATUS
[Date of request for examination] 13.12.2001
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-261449

(43)Date of publication of application : 13.09.2002

---

(51)Int.Cl. H05K 3/46

H01L 23/12

H01L 23/14

H01L 25/04

H01L 25/18

H05K 1/11

H05K 1/18

H05K 3/40

---

(21)Application number : 2001-379696

(22)Date of filing : 13.12.2001

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

(72)Inventor : NAKATANI SEIICHI

SUGAYA YASUHIRO

ASAHI TOSHIYUKI

KOMATSU SHINGO

(30)Priority

Priority number : 2000397728 Priority date : 27.12.2000 Priority country : JP

(54) MODULE WITH BUILT-IN COMPONENT AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a module with built-in component in which an inorganic filler can be applied at a high concentration, active components, such as the semiconductor or passive components, such as the chip resistor and chip capacitor can be embedded by a simple method, and a multilayer wiring structure can be produced easily.

SOLUTION: The module with the built-in component has a core layer made of an electrical insulating material and an electrical insulating layer and a plurality of wiring patterns formed on at least one surface of the core layer. The electrical insulating material of the core layer is composed of a mixture containing at least the inorganic filler and a thermosetting resin. The core layer incorporates at least one or more active component and/or passive components and has a plurality of wiring patterns and inner vias composed of a conductive resin. In addition, the elastic modulus of the electrical insulating material of the core layer composed of the mixture containing at least the inorganic filler and thermosetting resin at a room temperature is adjusted within the range of 0.6-10 GPa.

LEGAL STATUS

[Date of request for examination] 13.12.2001

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application

other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3547423

[Date of registration] 23.04.2004

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] It is the module with built-in components which equipped with an electric insulation layer and two or more circuit patterns at least one side of the core layer which consists of electric insulation material, and said core layer. It is formed from the mixture with which the electric insulation material of said core layer contains a minerals filler and thermosetting resin at least. At least one or

more active parts and/or passive components are built in the interior of said core layer. It has two or more inner beer with which said core layer consists of two or more circuit patterns and conductive resin. And the module with built-in components characterized by the modulus of elasticity in the room temperature of electric insulation material which consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least being in the range of 0.6-10GPa.

[Claim 2] It is the module with built-in components which equipped with an electric insulation layer and two or more circuit patterns at least one side of the core layer which consists of electric insulation material, and said core layer. It is formed from the mixture with which the electric insulation material of said core layer contains a minerals filler and thermosetting resin at least. At least one or more active parts and/or passive components are built in the interior of said core layer. It has two or more inner beer with which said core layer consists of two or more circuit patterns and conductive resin. The module with built-in components characterized by consisting of thermosetting resin with which the elastic modulus in the room temperature of electric insulation material which consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least is in the range of 0.6-10GPa, and said thermosetting resin has two or more glass transition temperature.

[Claim 3] It is the module with built-in components which equipped with an electric insulation layer and two or more circuit patterns at least one side of the core layer which consists of electric insulation material, and said core layer. It is formed from the mixture with which the electric insulation material of said core layer contains a minerals filler and thermosetting resin at least. At least one or more active parts and/or passive components are built in the interior of said core layer. It has two or more inner beer with which said core layer consists of two or more circuit patterns and conductive resin. The elastic modulus in the room temperature of electric insulation material which consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least is in the

range of 0.6-10GPa. And the module with built-in components characterized by said thermosetting resin consisting of thermosetting resin which has the glass transition temperature of the range of -20 to 60 degrees C at least, and thermosetting resin which has the glass transition temperature of the range of 70 to 170 degrees C.

[Claim 4] The module with built-in components with which it is a module according to claim 1 to 3 with built-in components, and the through hole which penetrates said core layers, said electric insulation layers, and said all circuit patterns is formed.

[Claim 5] The core layer which consists of electric insulation material, and the electric insulation layer which consists of electric insulation material formed from the mixture which contains a minerals filler and thermosetting resin at least in one side of said core layer, It is the module [equipped with two or more circuit patterns which consist of copper foil] according to claim 1 to 3 with built-in components. The module with built-in components to which it has two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and electrical connection of said circuit pattern is carried out with said inner beer.

[Claim 6] The module with built-in components to which electrical connection of the circuit pattern which has two or more inner beer which is the module [equipped with the core layer which consists of electric insulation material, the electric insulation layer which consists of electric insulation material formed at least in one side of said core layer from thermosetting resin, and two or more circuit patterns which consist of coppering] according to claim 1 to 3 with built-in components, and consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and consists of said coppering is carried out with said inner beer.

[Claim 7] The module with built-in components to which it is the module [equipped with the core layer which consists of electric insulation material, the electric insulation layer which thermosetting resin becomes from the organic film

formed in both sides at least at one side of said core layer, and two or more circuit patterns which consist of copper foil] according to claim 1 to 3 with built-in components, and it has two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and electrical connection of said circuit pattern is carried out with said inner beer.

[Claim 8] The module with built-in components which has two or more inner beer which is the module according to claim 1 to 3 with built-in components which the ceramic substrate which has two or more circuit patterns and inner beer pasted up at least on one side of the core layer which consists of electric insulation material, and said core layer, and consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin.

[Claim 9] The module with built-in components which consists of dielectric materials of a dielectric constant with which it has two or more inner beer which is the module according to claim 1 to 3 with built-in components which two or more ceramic substrates which have two or more circuit patterns and inner beer pasted up at least on one side of the core layer which consists of electric insulation material, and said core layer, and consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and said two or more ceramic substrates differ.

[Claim 10] The module according to claim 1 to 3 with built-in components which has arranged the film-like passive component between said circuit patterns formed at least in one side of said core layer.

[Claim 11] The module according to claim 10 with built-in components which is at least one chosen from the group which said film-like passive component becomes from the resistance and the capacitor which consist of mixture of a thin film or a minerals filler, and thermosetting resin, and an inductor.

[Claim 12] The module according to claim 10 with built-in components which is the solid electrolytic capacitor with which said film-like passive component consists of the oxidizing zone and conductive polymer of aluminum or a tantalum

at least.

[Claim 13] The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and active parts and/or a passive component are mounted on copper foil. Further copper foil by making said passive component and/or active parts buried in said sheet-like object in piles, and carrying out heating pressurization by carrying out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of copper foil [finishing / said component mounting], and putting it on it Stiffen the thermosetting resin and conductive resin in said sheet-like object, process the copper foil of the account of back to front outermost layer, make a circuit pattern form, and a core layer is created. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. The manufacture approach of the module with built-in components characterized by uniting at least with one side of said core layer by carrying out alignment of the mixture sheet or the organic film filled up with conductive resin at said through tube, and said copper foil, and carrying out heating pressurization in piles, processing said copper foil, and making a circuit pattern form.

[Claim 14] The manufacture approach of a module according to claim 13 with built-in components that the membranous part article is beforehand formed on said copper foil in the copper foil which carries out alignment and which is piled up on said core layer.

[Claim 15] The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in one side of a mold

release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing / said component mounting], and it is put on it. By making said sheet-like object carry out the flasking unification of said passive component and/or active parts, and carrying out heating pressurization further Stiffen the thermosetting resin and conductive resin in said sheet-like object, exfoliate the mold release carrier of the account of back to front outermost layer, and a core layer is formed. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. The mixture sheet or the organic film which filled up at least one side of said core layer with conductive resin at said through tube, The manufacture approach of the module with built-in components characterized by unifying by carrying out alignment of the mold release carrier which formed the circuit pattern in one side, and carrying out heating pressurization in piles, and exfoliating said mold release carrier.

[Claim 16] The manufacture approach of a module according to claim 15 with built-in components that the membranous part article is formed on the circuit pattern beforehand formed in said mold release carrier in said mold release carrier in which the piled-up circuit pattern which carries out alignment was formed on said core layer.

[Claim 17] The manufacture approach of a module according to claim 14 or 16 with built-in components that are at least one chosen from the group which said membranous part article becomes from the resistance and the capacitor which consist of mixture of a thin film or a minerals filler, and thermosetting resin, and an inductor, and said membranous part article is formed by the approach of either vacuum deposition, MO-CVD method or thick film printing.

[Claim 18] The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet.

A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and active parts and/or a passive component are mounted on copper foil. Further copper foil by making said passive component and/or active parts buried in said sheet-like object in piles, and carrying out heating pressurization by carrying out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of copper foil [finishing / said component mounting], and putting it on it Stiffen the thermosetting resin and conductive resin in said sheet-like object, process the copper foil of the account of back to front outermost layer, make a circuit pattern form, and a core layer is created. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. After carrying out alignment of the mixture sheet or the organic film filled up with conductive resin at said through tube, and said copper foil to at least one side of said core layer and carrying out heating pressurization hardening in piles, The manufacture approach of the module with built-in components characterized by forming through tubes also including a core layer and forming a penetration through hole by coppering.

[Claim 19] The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in one side of a mold release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing / said component mounting], and it is put on it. By making said sheet-like object carry out the flasking unification of said passive component and/or active parts, and

carrying out heating pressurization further Stiffen the thermosetting resin and conductive resin in said sheet-like object, exfoliate the mold release carrier of the account of back to front outermost layer, and a core layer is formed. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. The mixture sheet or the organic film which filled up at least one side of said core layer with conductive resin at said through tube, The manufacture approach of the module with built-in components characterized by forming through tubes also including a core layer and forming a penetration through hole by coppering after carrying out alignment of the mold release carrier which formed the circuit pattern in one side and carrying out heating pressurization hardening in piles.

[Claim 20] The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in one side of a mold release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing / said component mounting], and it is put on it. Furthermore, heating pressurization of the copper foil is carried out in the temperature region which said thermosetting resin does not harden in piles. Make said sheet-like object buried, make said passive component and/or active parts unify, and a core layer is formed. The ceramic substrate which formed inner beer and a circuit pattern at least in one side of a core layer [finishing / exfoliate said mold release carrier and / said exfoliation / core layer / said] more than two-layer at least is pressurized in piles. The manufacture approach of the module with built-in components characterized by stiffening the thermosetting resin in said core layer, and making it paste up

with said ceramic substrate.

[Claim 21] The manufacture approach of a module according to claim 20 with built-in components that the laminating of the ceramic substrate which has two or more of said circuit patterns and inner beer is carried out to two or more sheet coincidence through a core layer and a glue line.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the high-density-assembly module having passive components, such as active parts, such as a semi-conductor, and resistance, a capacitor.

[0002]

[Description of the Prior Art] In recent years, the high density of a semi-conductor and advanced features are further cried for with the demand of high-performance-izing of electronic equipment, and a miniaturization. Since this mounts them, a high-density thing which also has the small circuit board is desired. Since the inner beer hall continuation which is an electrical connection

method between the layers of the substrate which can connect the electric wiring between LSI and between components by the minimum distance as a means to realize high density assembly can attain high density wiring-ization of a circuit most to these demands, development is furthered in every direction.

[0003] However, mounting components in high density two-dimensional also by these approaches is approaching a limitation. Moreover, since the high density mounting board of such inner beer structures consists of ingredients of a resin system, thermal conductivity is low, and it becomes difficult to make the heat generated the more from components the more component mounting becomes high density radiate heat. soon -- being alike -- it is said that the clock frequency of CPU is set to about 1GHz, and an advancement and interval of the function also have the prediction to which the power consumption of CPU also tends to reach per [100-150W] one chip. It is becoming impossible moreover, to also bypass the effect of a noise in connection with improvement in the speed and densification. Therefore, as for the circuit board, high density and the appearance of the module of the three-dimension mounting gestalt which built in components [highly efficiently] in addition to an opposite noise and heat dissipation nature are expected.

[0004] To such a demand, a multilayered ceramic substrate is applied to JP,2-121392,A, and the module in which the capacitor and the resistor were formed inside is proposed. Although it is obtained by processing a substrate ingredient and the high dielectric materials in which coincidence baking is possible in the shape of a sheet, putting between the interior, and calcinating, by a gap of sintering timing and the difference in contraction at the time of sintering, camber may arise after baking, or exfoliation may arise in internal wiring, and such a ceramic multilayer substrate needs control of precise baking conditions, when carrying out coincidence baking of the ingredient of a different kind. Moreover, although a capacitor, a resistor, etc. can be formed since coincidence baking is a base as the components built-in by the ceramic substrate was shown previously, it is impossible to carry out coincidence baking of the semi-conductors, such as

silicon which lacks in thermal resistance, and it cannot be built in.

[0005] On the other hand, the proposal of the circuit board in which passive components, such as active parts, such as a semi-conductor, and a capacitor, resistance, were made to build at low temperature is made. Electronic parts are carried in copper wiring formed in printed circuit board material, further, it covers and embeds by resin on one side, a layer is formed on it, and the approach of pasting up two or more layers with adhesives further is indicated by JP,3-69191,A and JP,11-103147,A. Moreover, the approach of laying ingredients, such as a dielectric, underground in the through hole of penetration, forming a surface electrode in JP,9-214092,A, and building in a capacitor and resistance is indicated. In addition, there is also a method of making functions, such as a capacitor, add to the printed circuit board itself. The substrate with a built-in capacitor in which the electrode was formed to both sides of the dielectric substrate which mixed resin with dielectric powder is indicated by JP,5-7063,A (patent No. 3019541). Moreover, the approach in which a semi-conductor, a capacitor, etc. are made to build with an inner beer configuration is indicated by JP,11-220262,A.

[0006]

[Problem(s) to be Solved by the Invention] Thus, the three-dimension mounting module which has the inner beer structure in which the conventional high density wiring is possible, and contained components has a thing adapting the ceramic substrate excellent in heat dissipation nature and airtightness, and the thing to depend on the printed circuit board which can be stiffened at low temperature. In the ceramic substrate, while it excels in heat dissipation nature and the capacitor of a high dielectric constant can be built in, it is difficult to make coincidence calcinate an ingredient of a different kind, and it has the technical problem also in respect of that a semi-conductor cannot be made to build in or cost. It is difficult to obtain a high dielectric constant on the other hand, with the composite material which mixed resin with dielectric materials etc., although a semi-conductor may be able to be made to build in in the printed circuit board which can harden at low

temperature and it is advantageous also in cost. Even if this looks at the example of the printed circuit board which mixed the capacitor formed in the above-mentioned through hole, and dielectric powder, it is clear. Moreover, generally, thermal conductivity is low and, as for a printed circuit board, there is difficulty in heat dissipation nature. Moreover, it is difficult for the thickness of the module itself to become thick in order to lay discrete part underground, and to make the module volume small also with the approach of closing and carrying out two or more laminatings built-in of a semi-conductor, a capacitor, etc. which were mounted in the printed circuit board by resin, while discrete part can be built in. Moreover, although means, such as doubling forming the buffer coat which has a specific coefficient of thermal expansion between built-in components and a printed circuit board ingredient to the heat stress by the coefficient-of-thermal-expansion difference of built-in components and a printed circuit board, and the coefficient of thermal expansion of a printed circuit board ingredient, are taken, generally the coefficient of thermal expansion of a semi-conductor is small, and it is very difficult to make a coefficient of thermal expansion agree over an operating-temperature region only with a printed circuit board ingredient.

[0007] Then, this invention can fill up thermosetting resin with a minerals filler at high concentration, in order to solve said conventional problem, and it aims at offering the module with thermally conductive built-in components which can moreover be made to be able to lay passive components, such as active parts, such as a semi-conductor, and a chip resistor, a chip capacitor, under the interior by the simple method of construction, and can produce multilayer-interconnection structure simply. In this invention, the module with built-in components which has the overly high density mounting gestalt which modular production which has the desired engine performance is possible for, was moreover excellent in heat dissipation nature, and was excellent in choosing a minerals filler and thermosetting resin also at dielectric characteristics can be offered.

[0008]

[Means for Solving the Problem] In order to attain said purpose, the module with

built-in components of this invention It is the module with built-in components which equipped with an electric insulation layer and two or more circuit patterns at least one side of the core layer which consists of electric insulation material, and said core layer. It is formed from the mixture with which the electric insulation material of said core layer contains a minerals filler and thermosetting resin at least. At least one or more active parts and/or passive components are built in the interior of said core layer. It is characterized by the elastic modulus in the room temperature of electric insulation material which has two or more inner beer with which said core layer consists of two or more circuit patterns and conductive resin, and consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least being in the range of 0.6-10GPa.

[0009] The module which can lay passive components, such as active parts, such as a semi-conductor, and a chip resistor, a chip capacitor, under the interior by the simple method of construction by this, and has the desired engine performance by choosing the minerals filler and thermosetting resin of arbitration, and has high dependability also to stress, such as a thermal shock, can be offered. That is, the coefficient of thermal expansion of the modular direction of a flat surface can be doubled with a semi-conductor, or heat dissipation nature can be given. In addition, since components, such as a semi-conductor, can be built in without stress because the elastic modulus in the room temperature of electric insulation material considers as the range of 0.6-10GPa, the module which has an overly high density mounting gestalt is realizable. Moreover, since the multilayer high density wiring layer in which rewiring is possible can be formed in the front face of the core layer which built in components, a thin very high-density module is realizable. Furthermore, since the problem of the noise by progress of future high-frequency-izing can also carry out near of the arrangement of a semi-conductor and a chip capacitor as much as possible, the effectiveness of noise reduction is also expectable.

[0010] Moreover, by consisting of thermosetting resin with which the module with built-in components of this invention has an elastic modulus in the room

temperature of electric insulation material which consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least in the range of 0.6-10GPa, and said thermosetting resin has two or more glass transition temperature, even if the components which have various coefficients of thermal expansion are built in, a module strong against heat stress from the thermal shock of built-in components with built-in components is obtained.

[0011] Moreover, it is characterized by the module with built-in components of this invention consisting of thermosetting resin with which the elastic modulus in the room temperature of electric insulation material which consists of mixture of said core layer which contains a minerals filler and thermosetting resin at least is in the range of 0.6-10GPa, and said thermosetting resin has the glass transition temperature of the range of -20 to 60 degrees C at least, and thermosetting resin which has the glass transition temperature of the range of 70 to 170 degrees C. Even if the components which have various coefficients of thermal expansion by this are built in, a module still stronger against heat stress from the thermal shock of built-in components with built-in components is obtained.

[0012] Moreover, as for the module with built-in components of this invention, it is desirable that the through hole which penetrates said core layers, said electric insulation layers, and said all circuit patterns is formed.

[0013] Thereby, since the usual printed circuit board production process and a facility can use as it is in addition to the above, a module with built-in components can be realized very simply.

[0014] Moreover, the core layer which the module with built-in components of this invention becomes from electric insulation material, The electric insulation layer which consists of electric insulation material formed from the mixture which contains a minerals filler and thermosetting resin at least in one side of said core layer, It is said module equipped with two or more circuit patterns which consist of copper foil with built-in components, and it is desirable that have two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and electrical connection of said

circuit pattern is carried out with said inner beer.

[0015] The module which has the desired engine performance by being able to lay passive components, such as active parts, such as a semi-conductor, and a chip resistor, a chip capacitor, under the interior by the simple method of construction by this, and choosing the minerals filler of arbitration also as a surface wiring layer is possible. That is, the coefficient of thermal expansion of the modular direction of a flat surface can be doubled with a semi-conductor, or heat dissipation nature can be given. Moreover, since the multilayer high density wiring layer in which rewiring is possible can form in the front face of the core layer which built in components with an inner beer configuration, a thin very high-density module is realizable.

[0016] Moreover, the module with built-in components of this invention is said module equipped with the core layer which consists of electric insulation material, the electric insulation layer which consists of electric insulation material formed at least in one side of said core layer from thermosetting resin, and two or more circuit patterns which consist of coppering with built-in components, and it is desirable that electrical connection of the circuit pattern which has two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and consists of said coppering is carried out with said inner beer.

[0017] Since the existing plating technique can be used as it is in addition to the above and surface wiring and an insulating layer can moreover be formed thinly by this, a thinner high density module with built-in components is realizable.

[0018] Moreover, as for the module with built-in components of this invention, it is desirable that are said module equipped with the core layer which consists of electric insulation material, the electric insulation layer which thermosetting resin becomes from the organic film formed in both sides at least at one side of said core layer, and two or more circuit patterns which consist of copper foil with built-in components, have two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive

resin, and electrical connection of said circuit pattern is carried out with said inner beer.

[0019] It not only can form a high-density and thin surface wiring layer by this, but it excels in surface smooth nature extremely with an organic film. Moreover, since it excels in thickness precision similarly, impedance control of surface wiring can carry out very with high precision, and the module with built-in components for high frequency which suited the high frequency band can be realized.

[0020] Moreover, the module with built-in components of this invention is said module with built-in components which the ceramic substrate which has two or more circuit patterns and inner beer pasted up at least on one side of the core layer which consists of electric insulation material, and said core layer, and it is desirable to have two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin.

[0021] By this, components are built in, and it excels in heat dissipation nature or airtightness, and the module having the capacitor of a high dielectric constant is obtained.

[0022] Moreover, the module with built-in components of this invention is said module with built-in components which two or more ceramic substrates which have two or more circuit patterns and inner beer pasted up at least on one side of the core layer which consists of electric insulation material, and said core layer, and it is desirable to consist of dielectric materials of a dielectric constant with which it has two or more inner beer which consists of a circuit pattern with which said core layer consists of two or more copper foil, and conductive resin, and said two or more ceramic substrates differ.

[0023] The different-species laminating of a ceramic substrate with the low dielectric constant which was suitable for the ceramic condenser and the high-speed circuit of a high dielectric constant by this can be realized easily. Especially, the small ceramic layer of transmission loss can be used for a high-speed wiring layer, and a bypass capacitor can use the ceramic layer of a high

dielectric constant for a required part.

[0024] Moreover, as for the module with built-in components of this invention, it is desirable to arrange a film-like passive component between said circuit patterns formed at least in one side of said core layer. Thereby, the three-dimension module which contained components in high density further is realizable.

[0025] Moreover, as for the module with built-in components of this invention, it is desirable that it is at least one chosen from the group which said film-like passive component becomes from the resistance and the capacitor which consist of mixture of a thin film or a minerals filler, and thermosetting resin, and an inductor. It is because the passive component of the engine performance excellent in the thin film is obtained. Moreover, the membranous part article it is unrefined from a minerals filler and thermosetting resin is easy to manufacture, and it is because it excels also in dependability.

[0026] Moreover, as for the module with built-in components of this invention, it is desirable that it is the solid electrolytic capacitor with which said film-like passive component consists of the oxidizing zone and conductive polymer of aluminum or a tantalum at least.

[0027] Moreover, the manufacture approach of the module with built-in components of this invention The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and active parts and/or a passive component are mounted on copper foil. Further copper foil by making said passive component and/or active parts buried in said sheet-like object in piles, and carrying out heating pressurization by carrying out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of copper foil [finishing / said component mounting], and putting it on it Stiffen the thermosetting resin and conductive resin in said sheet-like object, process the copper foil of the account of back to front outermost layer,

make a circuit pattern form, and a core layer is created. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. It is characterized by uniting at least with one side of said core layer by carrying out alignment of the mixture sheet or the organic film filled up with conductive resin at said through tube, and said copper foil, and carrying out heating pressurization in piles, processing said copper foil, and making a circuit pattern form.

[0028] Since passive components, such as active parts, such as a semi-conductor, and a chip resistor, a chip capacitor, can be laid under the interior by the simple method of construction and components can be further mounted also in the outer layer section by this approach, a very high-density and small module is realizable. Moreover, since a circuit pattern can be formed also in the core surface section, it becomes a still higher-density module. Furthermore, since the ingredient of the surface section can be chosen, heat conduction, a dielectric constant, thermal expansion, etc. are controllable.

[0029] Moreover, as for the manufacture approach of the module with built-in components of this invention, in the copper foil which carries out alignment and which is piled up on said core layer, it is desirable that the membranous part article is beforehand formed on said copper foil.

[0030] Moreover, the manufacture approach of the module with built-in components of this invention The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in one side of a mold release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing

/ said component mounting], and it is put on it. By making said sheet-like object carry out the flasking unification of said passive component and/or active parts, and carrying out heating pressurization further Stiffen the thermosetting resin and conductive resin in said sheet-like object, exfoliate the mold release carrier of the account of back to front outermost layer, and a core layer is formed. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. It unifies by carrying out alignment of the mixture sheet or the organic film which filled up at least one side of said core layer with conductive resin at said through tube, and the mold release carrier which formed the circuit pattern in one side, and carrying out heating pressurization in piles, and is characterized by exfoliating said mold release carrier.

[0031] Since passive components, such as active parts, such as a semi-conductor, and a chip resistor, a chip capacitor, can be laid under the interior by the simple method of construction and components can be further mounted also in the outer layer section by this approach, a very high-density and small module is realizable. Furthermore, since the circuit pattern of the surface section can be formed by imprint, after a hardening process, processing of etching etc. becomes unnecessary and serves as a simple approach on industry.

[0032] Moreover, as for the manufacture approach of the module with built-in components of this invention, in said mold release carrier in which the piled-up circuit pattern which carries out alignment was formed on said core layer, it is desirable that the membranous part article is formed on the circuit pattern beforehand formed in said mold release carrier.

[0033] Moreover, the manufacture approach of the module with built-in components of this invention is at least one chosen from the group which said membranous part article becomes from the resistance and the capacitor which consist of mixture of a thin film or a minerals filler, and thermosetting resin, and an inductor, and it is desirable that said membranous part article is formed by the approach of either vacuum deposition, MO-CVD method or thick film printing.

[0034] Moreover, the manufacture approach of the module with built-in components of this invention The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and active parts and/or a passive component are mounted on copper foil. Further copper foil by making said passive component and/or active parts buried in said sheet-like object in piles, and carrying out heating pressurization by carrying out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of copper foil [finishing / said component mounting], and putting it on it Stiffen the thermosetting resin and conductive resin in said sheet-like object, process the copper foil of the account of back to front outermost layer, make a circuit pattern form, and a core layer is created. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. It is characterized by forming through tubes also including a core layer at least in one side of said core layer, and forming a penetration through hole in it by coppering, after carrying out alignment of the mixture sheet or the organic film which filled up said through tube with conductive resin, and said copper foil and carrying out heating pressurization hardening in piles.

[0035] Since it comes out that this uses the conventional penetration through-hole technology as it is on the basis of the core layer which built in components, it is very effective on industry.

[0036] Moreover, the manufacture approach of the module with built-in components of this invention The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in

one side of a mold release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing / said component mounting], and it is put on it. By making said sheet-like object carry out the flasking unification of said passive component and/or active parts, and carrying out heating pressurization further Stiffen the thermosetting resin and conductive resin in said sheet-like object, exfoliate the mold release carrier of the account of back to front outermost layer, and a core layer is formed. A through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening. The mixture sheet or the organic film which filled up at least one side of said core layer with conductive resin at said through tube, After carrying out alignment of the mold release carrier which formed the circuit pattern in one side and carrying out heating pressurization hardening in piles, it is characterized by forming through tubes also including a core layer and forming a penetration through hole by coppering.

[0037] Since it comes out that this uses the conventional penetration through-hole technology as it is on the basis of the core layer which built in components, it is very effective on industry.

[0038] Moreover, the manufacture approach of the module with built-in components of this invention The mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening, at least is processed in the shape of a sheet. A through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening. Fill up said through tube with conductive resin, and a circuit pattern is formed in one side of a mold release carrier. Active parts and/or a passive component are mounted on the circuit pattern of said mold release carrier. Carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing

/ said component mounting], and it is put on it. Furthermore, heating pressurization of the copper foil is carried out in the temperature region which said thermosetting resin does not harden in piles. Make said sheet-like object buried, make said passive component and/or active parts unify, and a core layer is formed. The ceramic substrate which formed inner beer and a circuit pattern at least in one side of a core layer [finishing / exfoliate said mold release carrier and / said exfoliation / core layer / said] more than two-layer at least is pressurized in piles. It is characterized by stiffening the thermosetting resin in said core layer, and making it paste up with said ceramic substrate.

[0039] By this approach, a very high-density and small module is realizable like the above. Moreover, since the ceramic substrate excellent in various engine performance can be unified, a still more highly efficient module is realizable.

[0040] Moreover, as for the manufacture approach of the module with built-in components of this invention, it is desirable to carry out the laminating of the ceramic substrate which has two or more of said circuit patterns and inner beer to two or more sheet coincidence through a core layer and a glue line. Since the laminating of the ceramic substrate of a different kind can be carried out thereby especially to coincidence, a very simple process is realizable.

[0041]

[Embodiment of the Invention] This invention builds one or more active parts and/or passive components in the interior of the electric insulation substrate which becomes thermosetting resin in the condition of not hardening from the mixture which added the minerals filler to high concentration as the 1st mode, and provides at least one side of a core layer which has inner beer which consists of conductive resin which connects electrically between two or more circuit patterns and these circuit patterns with the module with built-in components with which the electric insulation layer and the two or more layers circuit pattern were formed. This module contains a passive component and active parts, moreover, connects between circuit patterns from the inner beer by conductive resin, is what formed the circuit pattern with the multilayer

configuration on the core layer which built in components, and can realize a very high-density mounting gestalt. Moreover, it is possible for the coefficient of thermal expansion of the direction of a flat surface to be almost the same as a semi-conductor, and to give high temperature conductivity moreover by selection of a minerals filler. Moreover, that the elastic modulus in the room temperature of electric insulation material which consists of mixture of said core layer which built in one or more active parts and/or passive components which contains a minerals filler and thermosetting resin at least makes this module the range of 0.6-10GPa, and when said thermosetting resin consists of thermosetting resin which has two or more glass transition temperature, even if the components which have various coefficients of thermal expansion are built in, a module strong against stress from the thermal shock of built-in components with built-in components is obtained.

[0042] The module with built-in components of this invention is the mixture which made thermosetting resin add a minerals filler, and is obtained by it not being necessary to calcinate at an elevated temperature like a ceramic substrate, and heating at the low temperature which is about 200 degrees C. Moreover, since the minerals filler is added compared with the conventional resin substrate, there is effectiveness according to rank that a coefficient of thermal expansion, thermal conductivity, a dielectric constant, etc. are controllable to arbitration. In addition, it is good also as a through hole configuration which penetrates a core layer and a multilayer-interconnection layer. It is the the best for the micro power source module which could form the module with built-in components with the connection resistance low thereby very between layers, and contained components. When the mixture of a minerals filler and thermosetting resin is used for the electric insulation layer in which the shape of a multilayer similarly formed on the core layer was formed, it becomes possible like a core layer to control coefficient of thermal expansion, thermal conductivity, and a dielectric constant.

[0043] Moreover, the 2nd mode offers the module with built-in components which

the ceramic substrate which has a circuit pattern and inner beer pasted up at least on one side of a core layer which has inner beer which consists of a circuit pattern which contains at least one or more active parts and/or passive components in the electric insulation material which consists of mixture which contains a minerals filler and thermosetting resin at least, and consists of two or more copper foil, and two or more conductive resin and which is structure. Thereby, while building components in high density, it can have the various engine performance which a ceramic substrate has. That is, a ceramic substrate can control about [that high density wiring is possible] and a dielectric constant by about three to 10000 magnitude, and what also has large thermal conductivity is obtained. There is effectiveness according to rank that such engine performance can be used as it is. Furthermore, the module which has the high dependability which can carry out a laminating without stress even if it is the ceramic substrate which has the engine performance of a different kind and physical properties, and a crack does not produce to stress, such as a thermal shock, is realizable by using the above mentioned specific elastic modulus and the thermosetting resin of the glass-transition-temperature range.

[0044] The 3rd mode to moreover, the electric insulation material which consists of mixture which contains a minerals filler and thermosetting resin at least An electric insulation layer and a two or more layers circuit pattern are formed at least in one side of a core layer which has inner beer which contains at least one or more active parts and/or passive components, and consists of two or more circuit patterns and two or more conductive resin. And the module with built-in components of the structure where film-like active parts were formed between said circuit patterns formed on said core layer is offered. Since film-like components can be formed also in the wiring layer formed on the core layer by this while building components in high density, a module with built-in components with very high packaging density is realizable. Membranous part articles are the resistor which takes out the circuit pattern formed on the core layer, and is used as an electrode, a capacitor, and an inductor, and can form a resistor and a

capacitor in a circuit pattern with thick film printing or vacuum deposition at the configuration of arbitration.

[0045] Moreover, the 4th mode is related with the manufacture approach of a module with built-in components. Namely, the mixture of the thermosetting resin in a minerals filler and the condition of not hardening is processed in the shape of a sheet. Prepare the sheet-like object which formed the through tube and was filled up with conductive resin, and carry out alignment of what mounted active parts and a passive component on copper foil, and said sheet-like object, and they are piled up. Furthermore, in piles, said passive component and active parts are made buried in said sheet-like object, and copper foil is stiffened, a core layer is formed, the copper foil of said outermost layer is processed further, and a circuit pattern is formed. Next, a through tube is formed in the organic film in which the glue line was formed to the mixture sheet or both sides which consist of thermosetting resin in a minerals filler and the condition of not hardening, it unifies by carrying out alignment of what filled up said through tube with conductive resin, and the copper foil of said core layer, and carrying out heating pressurization in piles, copper foil is processed further, and a circuit pattern is formed.

[0046] Moreover, the 5th mode is related with the manufacture approach of a module with built-in components. That is, the mixture which consists of thermosetting resin in a minerals filler and the condition of not hardening is processed in the shape of a sheet, a through tube is formed in the sheet-like object which consists of thermosetting resin in said minerals filler and the condition of not hardening, and said through tube is filled up with conductive resin. On the other hand, a circuit pattern is formed in one side of a mold release carrier, and active parts and/or a passive component are mounted on this circuit pattern. Subsequently, carry out alignment of the sheet-like object which filled up said through tube with conductive resin to the component side of said mold release carrier which has a circuit pattern [finishing / said component mounting], put it on it, and carry out heating pressurization in the temperature region where

said thermosetting resin does not harden copper foil in piles further, and make said sheet-like object buried, said passive component and/or active parts are made to unify, and a core layer is formed. Furthermore, said mold release carrier is exfoliated, the ceramic substrate which formed inner beer and a circuit pattern at least in one side of said exfoliated core layer more than two-layer at least is pressurized in piles, the thermosetting resin in said core layer is stiffened, and it is made to paste up with said ceramic substrate from said core layer.

[0047] In the mode of the above-mentioned implementation, a ceramic substrate may be the multilayer capacitor of a high dielectric constant, and may carry out adhesion formation of the substrate which consists of two kinds of ceramic ingredients at coincidence. By pasting up the ceramic condenser of a high dielectric constant, and the ceramic substrate for high-speed circuits of a low dielectric constant on the core layer built in components, the module for high frequency with built-in components is obtained.

[0048] Next, the more concrete mode of the module with built-in components of this invention and its manufacture approach is explained based on a drawing.

[0049] Drawing 1 is the sectional view showing the configuration of the module with built-in components of this invention. In drawing 1 , 100 is the circuit pattern formed in the core layer 105, and 101 is the bare chip of the semi-conductor which is the active parts mounted on the circuit pattern 100. Moreover, 104 is a chip which is a passive component similarly mounted on the circuit pattern 100, and 102 is an electric insulation layer which consists of a composite material with which a minerals filler and thermosetting resin were compounded. 103 is inner beer which connects electrically between the circuit patterns 100 formed in the core layer 105. Furthermore, 106 is the electric insulation layer formed on the core layer 105, and 108 and 107 are the circuit patterns and inner beer of the maximum upper layer, respectively. Since it is possible to build in a semi-conductor 101 and a chip 104, and to mount components further on the surface circuit pattern 108 like drawing 1 , it becomes a very high-density mounting module.

[0050] As said thermosetting resin, an epoxy resin, phenol resin, and cyanate resin can be mentioned, for example. The approach a low elastic modulus or glass transition temperature adds low resin at a room temperature to each resin presentation as an approach of controlling the elastic modulus in the room temperature of said thermosetting resin and glass transition temperature at this time is mentioned. Moreover, as said minerals filler, aluminum 2O3, MgO, BN and AlN, and SiO2 grade can be mentioned. Moreover, if required, it is also possible to add a coupling agent, a dispersant, a coloring agent, and a release agent further to the composite of a minerals filler and thermosetting resin.

[0051] Drawing 2 is the sectional view showing another configuration of the module with built-in components of this invention. In drawing 2 , 209 is the penetration through hole formed so that the wiring layer formed on the core layer 205 and the core layer might be penetrated. The circuit pattern 208 formed in both sides of a core layer 205 and a core layer of the penetration through hole 209 is electrically connectable. Thereby, it is applicable to the power source module which needs a high current. In addition, the penetration through hole 209 can perform punching processing by the drill or laser processing, and can form a conductive layer in the wall surface of a through tube by the electrolytic copper galvanizing method, and also can form a circuit pattern by the FOTORISO method and the chemical etching method.

[0052] Drawing 3 is the sectional view showing another configuration of the module with built-in components of this invention. In drawing 3 , 305 is the electric insulation layer formed on the core layer 304, and 306 is the circuit pattern formed on the electric insulation layer 305. The electric insulation layer 305 can use photosensitive insulating resin, and even if it applies laminating film-like resin and a liquefied photopolymer by coater etc., it can form it. for example, the photopolymer formed in the shape of film -- FOTORISO -- inner beer 307 is processed by law and opening is carried out -- making -- further -- non-electrolytic copper plating and electrolytic copper plating -- a wiring layer -- forming -- further existing FOTORISO -- the electric insulation layer 305 is

obtained by forming a circuit pattern 306 by law. In addition, by carrying out by repeating this process, the wiring layer of multilayer structure is obtained and inner beer 307 can be formed using opening formed in the electric insulation layer 305. Moreover, it is possible to strengthen bond strength of the copper circuit pattern 306 by roughening said electric insulation layer before non-electrolytic copper plating.

[0053] Drawing 4 is the sectional view showing another configuration of the module with built-in components of this invention. Drawing 4 has the circuit pattern 407 formed like drawing 1 on the core layer 404 which built in the semi-conductor 401, inner beer 406, and the electric insulation layer 405. Furthermore, the membranous part article which takes out the circuit pattern 407 formed on the core layer 404, and is used as an electrode is formed. The membranous part article with which 409 expresses a resistor, and 408 are the membranous part articles showing a capacitor. Thus, it can consider as the very high-density module with built-in components with which the membranous part article 408 and 409 was further formed on the core layer 404 which built in components.

[0054] Drawing 5 is the sectional view showing another configuration of the module with built-in components of this invention. Drawing 5 is the configuration pasted up by the sheet-like object 510 which has inner beer 511 for carrying out electrical connection of the core layer 505 which built in the semi-conductor 501, and the multilayered ceramic substrate 509 obtained by carrying out coincidence baking of the inner beer 508 of a sintering mold, a circuit pattern 507, and the ceramic ingredient layer 506 like drawing 1 , and has the sheet-like object 512 and circuit pattern 514 which have inner beer 513 formed in the lower part of a ceramic substrate 509 still more nearly similarly. The solder ball 515 is formed on the above-mentioned circuit pattern 514, and a high-density module with built-in components is obtained. Thus, high density wiring is possible and a still more highly efficient module with built-in components is obtained by uniting with the ceramic substrate which has various engine performance.

[0055] Drawing 6 (a) - (h) is the sectional view showing the production process of

said module with built-in components. In drawing 6 (a), 602 is the sheet-like object which formed the through tube in what processed the mixture of the thermosetting resin in the above minerals fillers and the condition of not hardening, in the shape of a sheet, and filled up inner beer 603 with the conductive paste further. Processing of the sheet-like object 602 mixes a minerals filler and liquefied thermosetting resin, mixes the thermosetting resin which produced the paste-like kneading object or was hypoviscosity-ized with the solvent to the minerals filler, and produces a paste-like kneading object similarly. Next, the sheet-like object 602 is obtained by casting and heat-treating a paste-like kneading object in fixed thickness.

[0056] By what used liquefied resin, heat treatment is performed in order to remove adhesiveness, advancing some hardening and maintaining flexibility in the state of un-hardening, since it is adhesive. Moreover, by the kneading object in which resin was dissolved with the solvent, the above-mentioned solvent is removed, and adhesiveness is removed, holding flexibility in the state of un-hardening similarly. Thus, the through tube formed in the sheet-like object 602 in the produced condition of not hardening can be performed by processing with a laser process metallurgy mold, or punching processing. Especially, in a laser process, carbon dioxide laser and an excimer laser are effective in respect of working speed. A conductive paste uses the powder of gold, silver, and copper as an electrical conducting material, and can use the sheet-like object 602 and the thing which kneaded the same thermosetting resin for this. Especially copper has good conductivity, and since there is also little migration, it is effective. Moreover, the liquefied epoxy resin of thermosetting resin is stable in respect of thermal resistance.

[0057] Drawing 6 (b) shows the condition of having mounted the semi-conductor 601 and chip 604 which are active parts in copper foil 600. At this time, the semi-conductor 601 is electrically connected with copper foil 600 through electroconductive glue. A thing with a thickness of 18 to about 35 micrometers [which was produced by electrolytic plating] can be used for copper foil 600. In

order to improve an adhesive property with the sheet-like object 602 especially, the copper foil which roughened the contact surface with the sheet-like object 602 is desirable. Moreover, what carried out coupling processing of the copper foil front face, tin, zinc, and the thing that carried out nickel plating can be similarly used for prevention of an adhesive property and oxidation. What kneaded gold, silver, copper, a silver-palladium alloy, etc. with thermosetting resin similarly can be used for the electroconductive glue for flip chip mounting of a semi-conductor 601. Moreover, it is also possible to form beforehand in a semi-conductor side the bump by solder or the bump who produced by the golden wirebonding method, and to mount a semi-conductor 601 instead of electroconductive glue using the dissolution of the solder by heat treatment. Moreover, concomitant use of a solder bump and electroconductive glue is also possible.

[0058] Next, in drawing 6 (c), 600 is copper foil prepared separately and shows the condition of having carried out alignment of the copper foil 600 which mounted the sheet-like object 602 produced by the above-mentioned approach, the semi-conductor 601, and the chip 604 as shown in drawing, and having piled it up.

[0059] Next, drawing 6 (d) shows the condition of having carried out heating pressurization with a press, having laid the semi-conductor 601 and the chip 604 under said sheet-like object 602, and having unified what carried out alignment and was piled up. Laying under the ground of the components at this time is performed in the condition before the thermosetting resin in said sheet-like object 602 hardens, is heated further, is stiffened, and stiffens completely the thermosetting resin of said sheet-like object 602, and the thermosetting resin of conductive resin. Thereby, the sheet-like object 602, a semi-conductor 601, a chip 604, and copper foil 600 paste up firmly mechanically. Moreover, electrical installation between copper foil 600 is similarly performed by hardening of a conductive paste. Next, as shown in drawing 6 (e), thermosetting resin hardens, and the copper foil of the front face of the substrate which the semi-conductor

601 was laid underground and unified is processed, it considers as a circuit pattern 600, and a core layer 605 is produced. Drawing 6 (f) forms a through tube in the organic film in which the glue line was formed to the sheet-like object 606 or both sides which consist of mixture of the thermosetting resin in a minerals filler and the condition of not hardening, on the basis of the produced core layer 605, carries out alignment of what filled up said through tube with the conductive paste to both sides of a core layer 605, puts it on them, and piles up copper foil 608 further. A wiring layer can be formed in both sides of a core layer 605 like drawing 6 (g) by carrying out heating pressurization of this. Subsequently, a circuit pattern 609 can form the pasted-up copper foil 608 by the chemical etching method like drawing 6 (h). The module with built-in components which contained components by this is realizable. Then, although there are processes, such as component mounting by solder and restoration of insulating resin, since it is not essence here, it is omitting.

[0060] Drawing 7 (a) - (i) is the sectional view having shown the manufacture approach of the module with built-in components produced using the sheet-like object 704 produced like drawing 6 . In drawing 7 (a), the membranous part article 711 which takes out a circuit pattern 701 and a circuit pattern 701, and is used as an electrode is formed on the mold release carrier 700. After imprinting a circuit pattern 701 and the membranous part article 711, the mold release carrier 700 will be released from mold and organic films, such as polyethylene and polyethylene terephthalate, and metallic foils, such as copper, can be used for it. A circuit pattern 701 can be further formed with electrolysis plating etc. on what pasted up metallic foils, such as copper foil, on the mold release carrier 700 through adhesives, and a metallic foil. Thus, a circuit pattern 701 can be formed for the metal layer formed in the shape of film using the existing processing techniques, such as a chemical etching method. Drawing 7 (b) shows the condition of having mounted the semi-conductor 702 and the chip 703 to the circuit pattern 701 formed on the mold release carrier 700. Moreover, drawing 7 R> 7 (c) shows the sheet-like object 704 produced by carrying out like drawing 6 ,

and shows the condition of having processed the through tube by the same approach as drawing 6 , and having filled up the conductive paste with drawing 7 (d) into inner beer 705. The condition of having carried out alignment of the mold release carrier 700 in which the circuit pattern 701 was formed centering on the sheet-like object 704 in which the inner beer 705 which filled up with drawing 7 (e) the conductive paste produced by doing in this way was formed, and the mold release carrier 700 which has the components similarly mounted on the mold release carrier 700, and having piled it up is shown. Drawing 7 (f) showed the condition of having carried out heating pressurization of this, having stiffened the thermosetting resin in said sheet-like object 704, and having exfoliated the mold release carrier 700. According to this heating pressurization process, it will be in the condition of having laid the semi-conductor 702 and the chip 703 under said sheet-like object 704, and having unified. The semi-conductor 702 at this time and laying under the ground of a chip 703 are performed in the condition before the thermosetting resin in said sheet-like object 704 hardens, are heated further, are stiffened, and stiffen completely the thermosetting resin of said sheet-like object 704, and the thermosetting resin of a conductive paste. Thereby, the sheet-like object 704, a semi-conductor 702, and a circuit pattern 701 paste up firmly mechanically. Moreover, electrical installation of a circuit pattern 701 is similarly performed by hardening of the conductive paste of inner beer 705. At this time, beforehand, said sheet-like object 704 is further compressed by the thickness of the circuit pattern 701 on the mold release carrier 700, and a circuit pattern 701 is also laid under the sheet-like object 704 with it. Thereby, a circuit pattern and a module front face can form the core layer 706 with built-in components of a smooth condition.

[0061] Next, a multilayer module like drawing 7 (h) is producible by carrying out alignment of the mold release carrier 710 in which the sheet-like object 707 produced by drawing 7 (g) carrying out like drawing 7 (d) a core [the core layer 706 with built-in components produced by doing in this way] and the membranous part article 711 were formed, piling it up, and carrying out heating

pressurization. Finally the multilayer module of this invention completes the mold release carrier 710 by exfoliating like drawing 7 (i). Thus, the module with built-in components which contained still higher-density and various functions by using the mold release carrier in which the core layer which built in the semi-conductor and the chip, and a circuit pattern and a membranous part article were formed is obtained.

[0062] Drawing 8 (a) - (d) is the sectional view showing the manufacture approach of the module with built-in components obtained by carrying out a laminating to a multilayered ceramic substrate. Drawing 8 (a) shows the core layer 805 which built in the components shown by drawing 6 (e). Subsequently, the condition of drawing 8 (b) having carried out alignment of the sheet-like object 810 in which inner beer 811 was formed, and the sheet-like object 812 which formed inner beer 813 similarly as shown in drawing, and it having piled it up using this core layer 805 and multilayered ceramic substrate 809, and having piled up copper foil 814 further is shown. Next, as shown in drawing 8 (c), by carrying out heating pressurization of this layered product, the thermosetting resin in said sheet-like objects 810 and 812 hardens, and a core layer 805, a multilayered ceramic substrate 809, and copper foil 814 paste up firmly mechanically. And as shown in drawing 8 (d), the module with built-in components with which the multilayer ceramic and the core layer with built-in components were unified is completed by processing copper foil 814 finally, considering as a circuit pattern, and forming the solder ball 815. In addition, a multilayer ceramic wiring board is produced using the green sheet which consists of a low-temperature baking substrate ingredient which uses glass and an alumina as a principal component. That is, a through tube is formed in the green sheet by the ceramic ingredient which can be calcinated at about 900 degrees C, and it is filled up with the ********-strike which becomes this through tube from fine particles of high conductivity, such as copper or silver, and forms by printing a circuit pattern with the same conductive paste further, the laminating of two or more green sheets which carried out in this way and were produced is carried out,

and it is obtained by calcinating further. Thus, the high temperature conduction ingredient which uses as a principal component the high dielectric constant ingredient which uses barium titanate as a principal component according to the purpose, alumimium nitride, etc. may be used for the ceramic substrate ingredient produced, and the circuit pattern of the outermost layer of a ceramic layered product may be formed, does not need to perform only inner beer formation, and does not need to form a circuit pattern. Moreover, in drawing 8 (a) - (d), although the ceramic substrate of one sheet was used, by the two or more sheet sheet-like object, the laminating of the substrate which consists of said various kinds of ceramic ingredients may be carried out to coincidence, and it may be formed in it.

[0063]

[Example] Hereafter, this invention is explained to a detail based on an example.

[0064] (Example 1) On the occasion of production of the module with built-in components of this invention, it states from the production approach of the sheet-like object by the minerals filler and thermosetting resin first. In order to produce the sheet-like object used for this example, a minerals filler and liquefied thermosetting resin are first mixed with a stirring mixer. The used stirring mixer feeds the solvent for viscosity control into the container of a predetermined capacity a minerals filler, thermosetting resin, and if needed, it is made to revolve around the sun, rotating the container itself, and even if viscosity is comparatively high, sufficient distributed condition is acquired. The combination presentation of the carried-out sheet-like object for modules with built-in components is shown in Table 1 and 2.

[0065]

[Table 1]

	熱硬化性樹脂の組成					
	熱硬化性樹脂1			熱硬化性樹脂2		
	内容	質量%	Tg(℃)	内容	質量%	Tg(℃)
例1	エポキシ樹脂(旭チバ製 6041)	10	75	−	−	−
例2	エポキシ樹脂(日本ベルノックス製 WE-2025)	5	50	エポキシ樹脂(旭チバ製 6018)	5	130
例3	エポキシ樹脂(油化シェルエポキシ製 エピキュア YH-306)	10	110	−	−	−
比較例	エポキシ樹脂(旭チバ製 6099)	10	178	−	−	−

[0066]

[Table 2]

	無機質フィラーの組成		室温弾性率
	内容	質量%	(GPa)
例1	アルミナ粉、平均粒径12μm (昭和電工製 AS-40)	90	0.72
例2	アルミナ粉、平均粒径12μm (昭和電工製 AS-40)	90	7.6
例3	アルミナ粉、平均粒径12μm (昭和電工製 AS-40)	90	7.7
比較例	アルミナ粉、平均粒径12μm (昭和電工製 AS-40)	90	36.5

[0067] The concrete production approach takes weighing capacity and the specified quantity of the mixed paste-like mixture by the above-mentioned presentation, and is made to trickle them on a mold releasing film. Mixed conditions fed the minerals filler and said epoxy resin of the specified quantity into the container, and mixed them with the kneading machine this whole container. While a kneading machine makes a container revolve around the sun, it is carried out by the approach of making it rotate, and kneading is performed in a short time for about 10 minutes. Moreover, the polyethylene terephthalate film to which mold release processing by silicon was performed on the front face with a thickness of 75 micrometers as a mold releasing film was used. The mold releasing film was further put on the mixture on the mold releasing film made dropped, and it pressed so that it might become fixed thickness with a pressurization press. Next, the mold releasing film of one side was made to exfoliate, mixture was heated the whole mold releasing film, and it heat-treated under the conditions whose adhesiveness remove a solvent and is lost. The

temperature of heat treatment conditions is maintenance for 15 minutes at 120 degrees C. Thereby, said mixture turns into a sheet-like object without adhesiveness with a thickness of 500 micrometers. Since hardening initiation temperature is 130 degrees C, under said heat treatment conditions, said thermosetting epoxy resin is in the condition (B stage) of not hardening, and can carry out melting again with heating at subsequent processes.

[0068] Thus, in order to evaluate the physical properties of the produced sheet-like object, the heat press was performed, the hardened material of sheet-like mixture was created, and the elastic modulus of a hardened material and glass transition temperature were measured. The conditions of a heat press sandwiched the created sheet-like object with the mold releasing film, at 200 degrees C, with the pressure of 4.9MPa, carried out the heat press and performed it for 2 hours. The elastic modulus and glass transition point (Tg) in a room temperature of a hardened material are shown in Table 1 and 2, and the temperature characteristic of an elastic modulus is shown in drawing 9 , respectively. The elastic modulus in the room temperature of a hardened material is about 8 GPa extent from about 0.7 GPa extent, and the thing using the epoxy resin of 36.5GPa(s) as an example of a comparison also prepared it as it was shown in Table 1 and 2. Moreover, it evaluated also about what mixed the epoxy resin with which glass transition temperature differs like Example 2. In addition, it asks for glass transition temperature from Tandelta which shows the viscous behavior of an elastic modulus based on the temperature characteristic of elastic-modulus E' as shown in drawing 10 . It is what showed the temperature characteristic of elastic-modulus E' of Example 2, and, as for drawing 10 , the point of inflection of Tandelta shows that the glass transition points of this mixture are 50 degrees C and 130 degrees C, respectively.

[0069] The sheet-like object in the condition of having the above physical properties and of not hardening was cut into predetermined magnitude, and the through tube with a diameter of 0.15mm was formed in the location at equal intervals whose pitch is 0.2mm - 2mm using carbon dioxide laser. To this through

tube, as a conductive paste for beer hall restoration, globular form copper grain child 85 mass % with a mean particle diameter of 2 micrometers, As a resin presentation, bisphenol A mold epoxy resin (product made from oil-ized shell epoxy "Epicoat 828") 3 mass %, and guru SHIJIRU ester system epoxy resin (Tohto Kasei make "YD-171") 9 mass %, It was filled up with what kneaded amine adduct curing agent (Ajinomoto make "MY-24") 3 mass % with 3 rolls as a curing agent with screen printing (refer to drawing 6 (a)). Next, the electroconductive glue which becomes copper foil 600 which roughened 35-micrometer one side from silver dust and an epoxy resin about a semi-conductor 601 and a chip 604 performs flip chip mounting. Thus, alignment of the copper foil 600 which mounted the produced semi-conductor, and the copper foil 600 with a thickness of 35 micrometers which was prepared separately and which carried out one side roughening processing is carried out to a sheet-like object, and they are inserted into it. At this time, the roughening side of copper foil has been arranged so that it may be on a sheet-like object side. Subsequently, heating pressurization is carried out for 5 minutes by the press temperature of 120 degrees C, and pressure 0.98MPa using a heat press. Thereby, in order that the thermosetting resin in said sheet-like object 602 may carry out melting softening with heating, a semi-conductor 601 and a chip 604 are buried into a sheet-like object. Furthermore, whenever [stoving temperature] was raised and it held for 60 minutes at 175 degrees C. The epoxy resin in a sheet-like object and the epoxy resin in conductive resin harden by this, and the core layer 605 which a sheet-like object, a semi-conductor, and copper foil pasted up firmly mechanically, and the conductive paste pasted up electrically (inner beer connection) and mechanically with said copper foil is obtained. The copper foil of the front face of a core layer 605 under which this semi-conductor was laid is etched with an etching technique, and an electrode pattern with a diameter of 0.2mm and a circuit pattern 600 are formed on an inner beer hall.

[0070] Thus, it multilayers using the produced core layer 605. The used sheet-like object used the carbon-dioxide-laser processing machine for what applied

the epoxy resin (Japanese Lec make "EF-450") as adhesives to both sides of an aramid film (Asahi Chemical make "Aramica") with a thickness of 25 micrometers to the thickness of 5 micrometers, and performed hole processing to it. What the processed bore diameter is 100 micrometers and filled this up with the above-mentioned conductive paste was used (refer to drawing 6 (f)). Thus, alignment of the sheet-like object in which the glue line was formed was carried out to both sides of said core layer 605, it was put on the produced organic film to them, and heating pressurization of the copper foil 608 with a thickness of 18 micrometers which carried out one side roughening processing was carried out further in piles. And pattern formation of the copper foil 608 of the maximum upper layer was carried out, and the module with built-in components was obtained.

[0071] As reliability evaluation of the module with built-in components produced by this approach, the moisture absorption reflow trial and the spalling test (heat cycle test) were performed. The moisture absorption reflow trial was performed because a maximum temperature lets once the module with built-in components held under conditions of the temperature of 85 degrees C, and 85% of humidity for 168 hours pass to a belt type reflow testing machine for 20 seconds at 240 degrees C. Moreover, an elevated-temperature side holds for 30 minutes each at the temperature which is -40 degrees C, and a 125-degree-C and low temperature side is [a spalling test] 1000 cycle ********.

[0072] When the resistance of the inner beer connection (100 inner beer is connected to a serial) formed in incore one with built-in components was less than **10% as evaluation after each trial, it considered as the excellent article, and that to which an open circuit and 10% or more connection resistance went up was made into the defect. Moreover, what does not have an open circuit of the plane of composition of the built-in components and degradation of the components engine performance as a valuation basis of built-in components was used as the excellent article, and it carried out to the thing from which the electrical connection of built-in components changed **10% or more like inner beer, or the poor thing from which the components engine performance changed.

At this time, geometrically a crack did not generate the semi-conductor module and especially abnormalities were not accepted with ultrasonic test equipment, either. In addition, as built-in components, the chip resistor (20 pieces), the chip capacitor (20 pieces), and the semi-conductor for a test (one chip: 30 connection terminals) were used. The result of the reliability evaluation is shown in Table 3.

[0073]

[Table 3]

	室温弾性率 (GPa)	ガラス転移点 Tg(℃)	信頼性評価項目			
			熱衝撃試験 (不良数/試験数)		吸湿リフロー試験 (不良数/試験数)	
			ビア接続信頼性	内蔵部品信頼性	ビア接続信頼性	内蔵部品信頼性
例 1	0.72	75	0/100	0/70	2/100	1/70
例 2	7.6	50/130	0/100	0/70	0/100	0/70
例 3	7.7	110	1/100	0/70	0/100	0/70
比較例	36.5	178	12/100	25/70	9/100	34/70

[0074] If the range of the elastic modulus in a room temperature is 0.6 or more Gpas and 10 GPas or less so that clearly from Table 3, it turns out that good dependability is acquired. Since the modulus of elasticity of a room temperature is especially high in the example of a comparison, inner beer connection and degradation of built-in components are conspicuous with the stress stress at the time of a thermal shock. To the stress produced according to the difference of each coefficient of thermal expansion, if this has a high elastic modulus, it will serve as high stress, and it is considered because the components connection which stress concentrates is disconnected. Moreover, in the example of a comparison, since glass transition temperature is high, an elastic modulus is considered to be based on a high thing also at an elevated temperature. Compared with it, comparatively high dependability is acquired from Example 1 in Example 3. In Example 2 using the epoxy resin of two classes with which especially elastics modulus differ, since an elastic modulus falls greatly with the rise of temperature even if the elastic modulus of a room temperature is not so low (refer to drawing 10), it is thought that high dependability can be held. Moreover, although it has the engine performance good about a spalling test in

the electrical insulation material of the example 1 with the lowest elastic modulus of a room temperature, in a reflow trial in the moisture absorption condition, dependability is a little inferior. Although this is the dependability of extent without a real use top problem, since moisture absorption becomes large, what has a low elastic modulus poses a problem by moisture absorption reflow trial more than this. Therefore, in order to acquire still better dependability, it is clear that it is good to use the epoxy resin which has two or more elastics modulus and glass transition temperature like Example 2.

[0075] Thereby, it turns out that adhesion with firm semi-conductor and module is obtained. Moreover, as for the inner beer connection resistance by the conductive paste, most did not have the initial engine performance and change in a core layer and a wiring layer.

[0076] (Example 2) Example 2 of an example 1 and the example of the module in which the semi-conductor was made to build using the same sheet-like object are shown.

[0077] The sheet-like object 704 with a thickness of 500 micrometers which filled up with the conductive paste the through tube produced on the same conditions as an example 1 was prepared (refer to drawing 7 (d)). Next, copper foil with a thickness of 70 micrometers was used as the mold release carrier, and copper with a thickness of 9 more micrometers was formed on the mold release carrier with electrolytic copper plating. A circuit pattern is formed using this mold release carrier. the mold release carrier in which copper with a thickness of 9 micrometers was formed -- FOTORISO -- chemical etching is carried out by law and the circuit pattern 701 shown in drawing 7 (a) is formed. Thus, the solder bump performed flip chip mounting for the semi-conductor and the chip on the produced mold release carrier with a circuit pattern. Furthermore, the membranous part article was formed by printing on the mold release carrier which has another circuit pattern. The membranous part article 711 is resistive paste which mixed carbon powder to thermosetting resin. Printing was performed with the existing screen printing.

[0078] Thus, alignment of the mold release carrier which mounted the produced semi-conductor, and the mold release carrier which has only the circuit pattern prepared separately is carried out to the sheet-like object 704 filled up with said conductive paste, and it is inserted into it. At this time, the circuit pattern has been arranged so that it may be on a sheet-like object side. Heating pressurization of this is carried out for 5 minutes by the press temperature of 120 degrees C, and pressure 0.98MPa using a heat press. Thereby, in order that the thermosetting resin in said sheet-like object 704 may carry out melting softening with heating, a semi-conductor 702 and a chip 703 are buried into a sheet-like object. Furthermore, whenever [stoving temperature] was raised and it held for 60 minutes at 175 degrees C. The epoxy resin in a sheet-like object and the epoxy resin under conductive paste harden by this, and a sheet-like object, a semi-conductor, and a circuit pattern paste up firmly mechanically. Furthermore, a conductive paste pastes up electrically (inner beer connection) and mechanically with said circuit pattern 701. Next, the mold release carrier of the front face of a hardened material under which this semi-conductor was laid was exfoliated. Since a mold release carrier has a glossy surface and has formed the wiring layer in electrolytic plating, it can make only the copper foil which is a mold release carrier exfoliate. The core layer 706 in which components were built in this condition has been formed. Subsequently, a wiring layer is further formed using this core layer 706. By this approach, in order to use the mold release carrier which formed the circuit pattern beforehand, the module after hardening serves as a flat core layer by which the circuit pattern was also embedded in the module. By this, a detailed multilayer interconnection can be formed in a core layer front face. Moreover, a sheet-like object is compressed by the thickness of a surface circuit pattern by laying a circuit pattern underground similarly. Therefore, the electrical installation of a ********-strike with good dependability is obtained.

[0079] Subsequently, a multilayer-interconnection layer is further formed using this core layer which built in the semi-conductor and the chip. It puts like drawing

7 (g) using the mold release carrier 700 which has the circuit pattern 701 which formed the membranous part article 711 in both sides of the above-mentioned core layer further using the sheet-like object with a thickness of 100 micrometers filled up with the conductive paste produced in the example 1. On the same conditions as the above, heating pressurization is carried out, this is stiffened, and the circuit pattern 701 and the membranous part article 711 on a core layer and a mold release carrier are made to unify. Furthermore, the module with built-in components of this invention is obtained by exfoliating the mold release carrier 710 after hardening. Thus, by using a mold release carrier, wet processes, such as chemical etching, become unnecessary at the time of substrate production, and a simply detailed circuit pattern is obtained at it. Moreover, since the mold release carrier using an organic film can estimate the mounting engine performance before building in components, there is effectiveness according to rank that faulty components are fixable on a mold release carrier.

[0080] As reliability evaluation of the module with built-in components produced by this approach, the moisture absorption reflow trial and the spalling test (heat cycle test) were performed. The moisture absorption reflow trial and the spalling test were performed under the same conditions as an example 1. Geometrically at this time, a crack did not generate the semi-conductor module, and especially abnormalities were not accepted with ultrasonic test equipment, either. Thereby, it turns out that adhesion with firm semi-conductor and module is obtained. Moreover, the inner beer connection resistance by the conductive paste, built-in components connection, and the components engine performance did not almost have the initial engine performance and change, either.

[0081] (Example 3) The example which produces a still higher-density module using the core layer and multilayered ceramic substrate in which the semi-conductor was made to build using the same sheet-like object as Example 2 of an example 1 is shown.

[0082] The core layer 805 which built in the semi-conductor 802 produced on the same conditions as an example 1 was used (refer to drawing 8 (a)). The

thickness of a core layer is 300 micrometers. Next, a glue line performs a laminating for a multilayered ceramic substrate 809 and said core layer 805. In addition, a ceramic multilayer-interconnection substrate is produced using a green sheet (Nippon Electric Glass make "MLS-1000") with a thickness of 220 micrometers it is thin from the low-temperature baking substrate ingredient which uses glass and an alumina as a principal component. Namely, a multilayer-interconnection substrate performs hole processing with a diameter of 0.2mm to this green sheet by the puncher as a through tube. Use the silver dust object of 2 micrometers of mean diameters as a principal component at this through tube, and it is filled up with the ********-strike which mixed the terpineol solvent with ethyl cellulose resin. Furthermore, it produced by forming by printing a circuit pattern with the same conductive paste, carrying out the laminating of two or more green sheets which carried out in this way and were produced by the pressure of 4.9MPa(s) with the temperature of 70 degrees C, and calcinating at 900 more degrees C in 1 hour.

[0083] Next, a through tube is formed in the sheet-like object produced like an example 1, the sheet-like objects 810 and 812 with a thickness of 100 micrometers further filled up with the conductive paste are prepared, and the unified module which carried out alignment of said core layer 805 and multilayered ceramic substrate 809 like drawing 8 (b), piled them up, and carried out heating pressurization is produced. At this time, copper foil 814 may be united with the sheet-like object of the lowest layer in piles, and a circuit pattern may be imprinted using the mold release carrier which formed the membranous part article like drawing 7 (a). In addition, a solder ball can be mounted in the circuit pattern of the module formed by doing in this way, and it can consider as a connection terminal.

[0084] As reliability evaluation of the module with built-in components produced by this approach, the same moisture absorption reflow trial as an example 1 and the spalling test (heat cycle test) were performed. Though it was the composite module by which the laminating of the semi-conductor module was carried out to

the ceramic substrate at this time, geometrically a crack did not occur and especially abnormalities were not accepted with ultrasonic test equipment, either. Thereby, it turns out that adhesion with firm semi-conductor and module is obtained.

[0085] Moreover, in order to evaluate modular shock resistance, the shatter strength dropped from height of 1.8m was evaluated. Specifically mounted the completed module with soldering on the glass epoxy group plate, and set to the container made from aluminum, and it was made to fall on concrete, and investigated whether a module would be damaged. Only in the case of said ceramic substrate produced as an example of a comparison, the crack arose in the moiety, but there was no generating of a crack by the module of an example 3. Also from this, it is thought that some which were pasted up by said sheet-like object have the work as a stress relaxation layer which is not obtained only by the ceramic substrate, and it can be called the effectiveness according to rank of this invention.

[0086] Moreover, the inner beer connection resistance by the conductive paste did not almost have the initial engine performance and change, either.

[0087]

[Effect of the Invention] Since according to the module with built-in components of this invention active parts and/or a passive component can be laid under the interior and a circuit pattern and the multilayer interconnection by the electric insulation layer can moreover form at least in the one side at coincidence by using the sheet-like object by thermosetting insulation resin and the mixture of a high-concentration minerals filler as explained above, a very high-density module is realizable. Moreover, it is possible to control thermal conductivity, a coefficient of thermal expansion, and a dielectric constant by selecting a minerals filler. This can make the coefficient of thermal expansion of the direction of a flat surface almost the same as a semi-conductor, and is effective also as a substrate which mounts a semi-conductor directly. Furthermore, it is effective by raising thermal conductivity also as a substrate which mounts the semi-conductor which needs

heat dissipation. In addition, it is also possible to make a dielectric constant low and it is effective also in the substrate of loss low as an object for RF circuits. In addition, the module with built-in components which has high dependability to heat stress, such as a spalling test, by making the elastic modulus in the room temperature of thermosetting resin and glass transition temperature into the specific range is realizable.

[0088] Moreover, according to the manufacture approach of the module with built-in components of this invention, process into a sheet-like object the mixture containing the thermosetting resin in a minerals filler and the condition of not hardening, and a through tube is formed. What prepared the sheet-like object filled up with conductive resin, formed the circuit pattern in one side of a mold release carrier upwards, and mounted active parts and a passive component, The module with built-in components of this invention is obtained by carrying out alignment of said sheet-like object, piling it up, piling up by carrying out the circuit pattern side of the mold release carrier which has a circuit pattern on said mold release carrier produced further separately inside, making said sheet-like object carry out flasking unification, and making it harden by heating pressurization. Furthermore, the membranous part article which takes out the circuit pattern formed on the mold release carrier at this time, and is used as an electrode can also be formed in coincidence. Since a circuit pattern can also be laid under said sheet-like object while it is realizable by this by the approach with the very high-density simple module having active parts or a passive component, a module with a smooth front face is realizable. Thereby, since there is no level difference of a circuit pattern in the front face of the module of this invention, components can be further mounted in high density.

[0089] Moreover, since the manufacture approach of a module with built-in components of having the multilayer structure of this invention can also form a multilayered ceramic substrate in coincidence at a inner layer, it it not only can build in active parts, such as a semi-conductor, and passive components, such as a chip resistor, but can realize a very high-density module. Moreover, since

the laminating of the ceramic substrate which has various engine performance can be carried out to two or more coincidence, a very highly efficient module is realizable.

[0090] As mentioned above, since this invention can build active parts and a passive component in a module and can connect between circuit patterns from inner beer, it is realizable by the approach with a very high-density simple module.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the module with built-in components which has the multilayer structure by one example of this invention.

[Drawing 2] It is the sectional view of the module with built-in components which has the multilayer structure by one example of this invention.

[Drawing 3] It is the sectional view of the module with built-in components which has the multilayer structure by one example of this invention.

[Drawing 4] It is the sectional view of the module with built-in components which has the multilayer structure by one example of this invention.

[Drawing 5] It is the sectional view of the module with built-in components which has the multilayer structure by one example of this invention.
[Drawing 6] It is the sectional view showing the production process of a module with built-in components which has the multilayer structure by one example of this invention.
[Drawing 7] It is the sectional view showing the production process of a module with built-in components which has the multilayer structure by one example of this invention.
[Drawing 8] It is the sectional view showing the production process of a module with built-in components which has the multilayer structure by one example of this invention.
[Drawing 9] It is drawing having shown the temperature characteristic of the elastic modulus of the electrical insulation material of a module with built-in components.
[Drawing 10] It is drawing having shown elastic-modulus E' and Tandelta of the electrical insulation material which is one example of the module with built-in components of this invention.
[Description of Notations]
100, 108, 200, 208, 300, 306, 400, 407, 500, 504, 507, 514, 609, 701, 709, 801, 807 Circuit pattern
101, 201, 301, 401, 501, 601, 702, 802 Semi-conductor
102, 106, 202, 206, 302, 305, 402, 405, 502, 803 Electric insulation layer
103, 107, 207, 303, 307, 403, 406, 503, 508, 511, 513, 603, 607, 705, 708, 804, 808, 811, 813 Inner beer
104, 204, 604, 703 Chip
105, 205, 304, 404, 505, 605, 706, 805 Core layer
209 Penetration through Hole
408 Capacitor
409 Resistor
506 806 Ceramic ingredient layer

509 809 Multilayered ceramic substrate

510, 512, 602, 606, 704, 707, 810, 812 Sheet-like object

515 815 Solder ball

600, 608, 814 Copper foil

700 710 Mold release carrier

711 Membranous Part Article

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

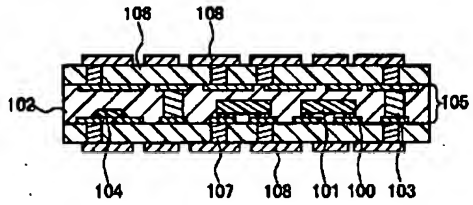
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

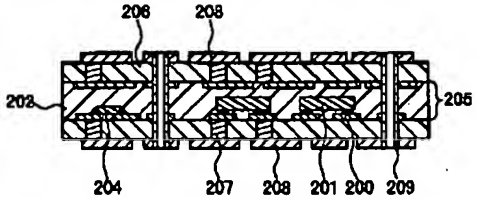
3.In the drawings, any words are not translated.

DRAWINGS

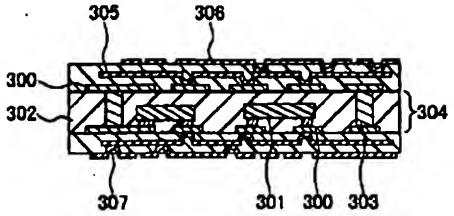
[Drawing 1]



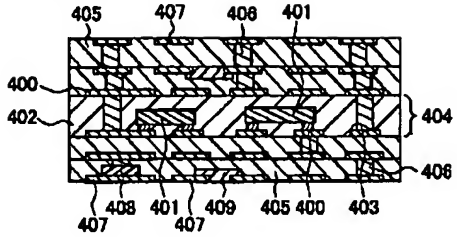
[Drawing 2]



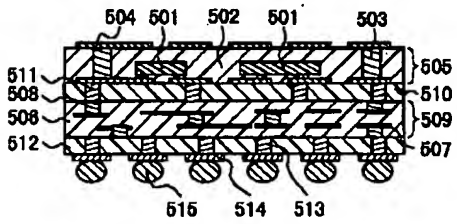
[Drawing 3]



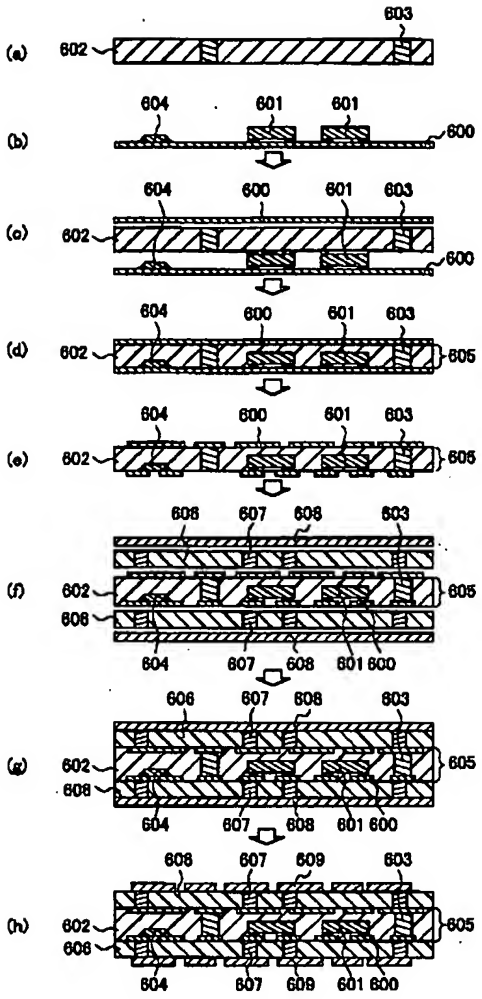
[Drawing 4]



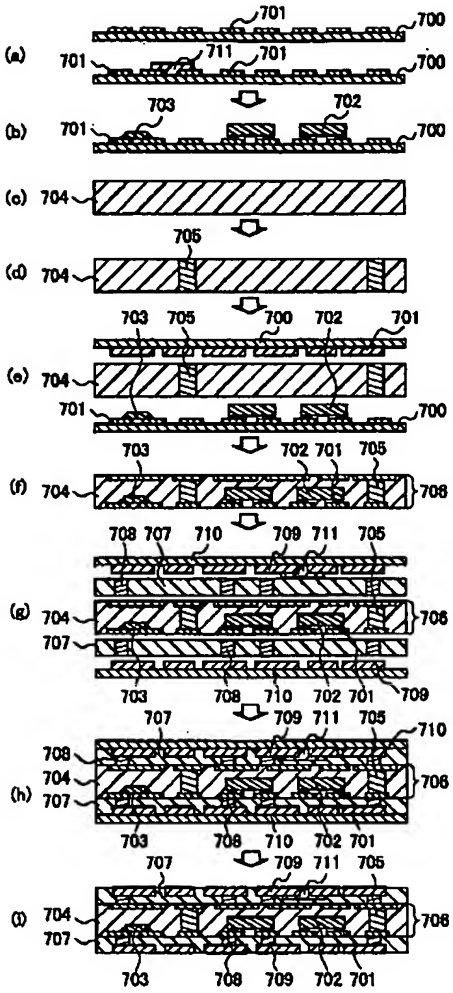
[Drawing 5]



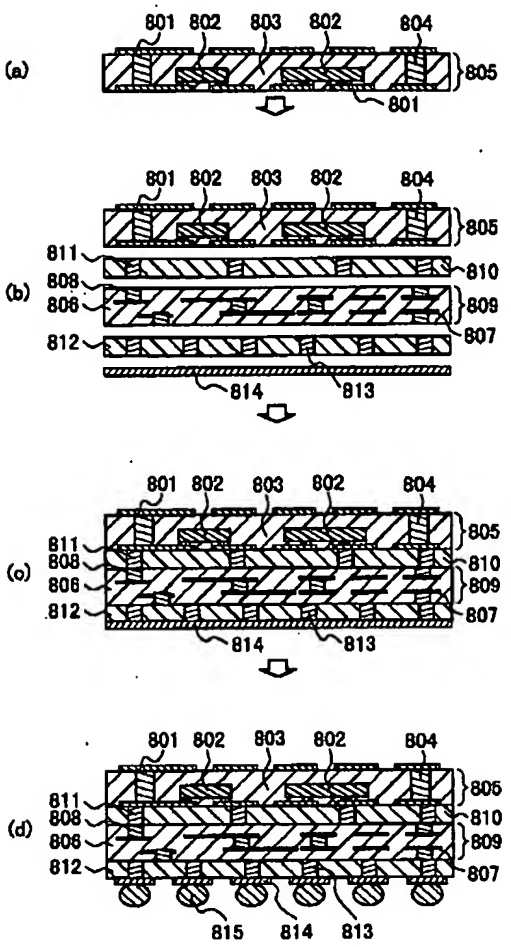
[Drawing 6]


(a)
602
603
(b)
604
601
601
600
(c)
602
604
600
601
603
600
(d)
602
604
600
601
603
605
(e)
602
604
600
601
603
605
(f)
602
606
608
607
608
603
605
604
607
608
601
600
(g)
602
606
608
607
608
603
605
604
607
608
601
600
(h)
602
606
608
607
609
603
605
604
607
609
601
600

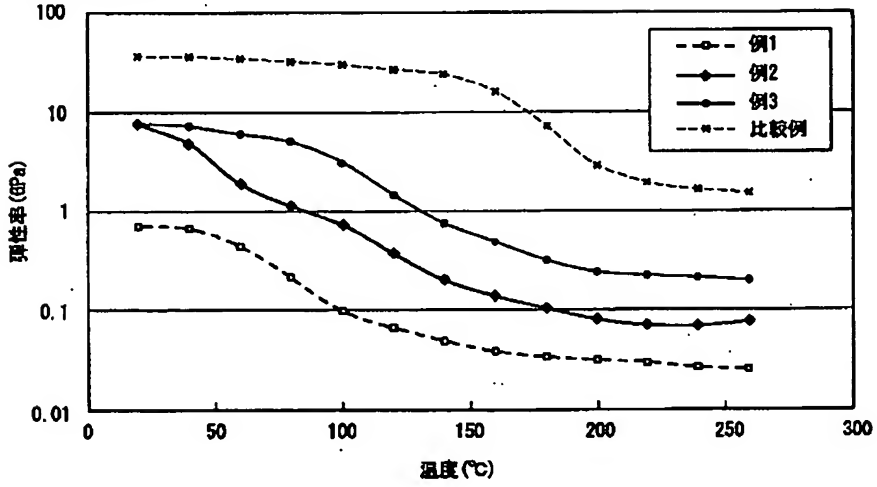
[Drawing 7]



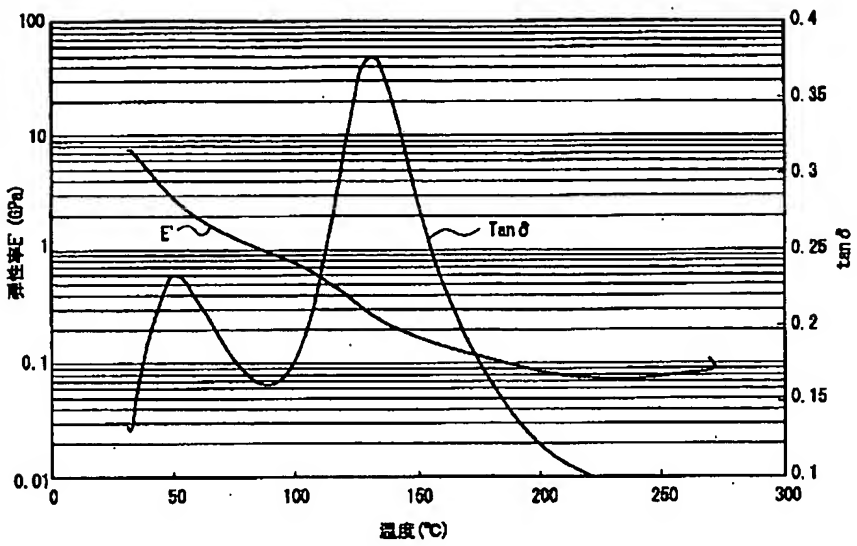
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2002－261449
（P2002－261449A）
(43)公開日　平成14年９月13日(2002.9.13)

(51)Int.Cl.'	識別記号	ＦＩ		テーマコード'（参考）
Ｈ０５Ｋ　3/46		Ｈ０５Ｋ　3/46	Ｑ	５Ｅ３１７
			Ｃ	５Ｅ３３６
			Ｌ	５Ｅ３４６
			Ｎ	
			Ｔ	

審査請求　有　請求項の数21　ＯＬ　（全 18 頁）　最終頁に続く

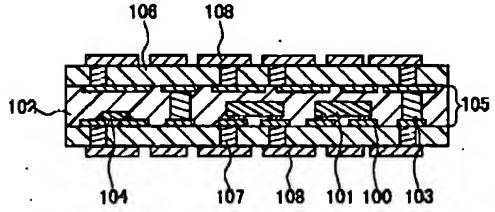
(21)出願番号　特願2001－379696(P2001－379696)
(22)出願日　平成13年12月13日(2001.12.13)
(31)優先権主張番号　特願2000－397728(P2000－397728)
(32)優先日　平成12年12月27日(2000.12.27)
(33)優先権主張国　日本（ＪＰ）

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　中谷　誠一
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(72)発明者　青谷　康博
大阪府門真市大字門真1006番地　松下電器産業株式会社内
(74)代理人　110000040
特許業務法人池内・佐藤アンドパートナーズ

最終頁に続く

(54)【発明の名称】　部品内蔵モジュール及びその製造方法

(57)【要約】
【課題】　無機質フィラーを高濃度に充填することが可能で、しかも簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設させ、且つ多層配線構造を簡易に作製することができる熱伝導性部品内蔵モジュールを提供する。
【解決手段】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に電気絶縁層と複数の配線パターンとを備えた部品内蔵モジュールであって、前記コア層の電気絶縁材が少なくとも無機質フィラーと熱硬化性樹脂を含む混合物から形成され、前記コア層の内部に少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、前記コア層が複数の配線パターンと導電性樹脂からなる複数のインナービアを有し、且つ前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にある部品内蔵モジュールとする。



【特許請求の範囲】

【請求項１】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に電気絶縁層と複数の配線パターンとを備えた部品内蔵モジュールであって、前記コア層の電気絶縁材が少なくとも無機質フィラーと熱硬化性樹脂を含む混合物から形成され、前記コア層の内部に少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、前記コア層が複数の配線パターンと導電性樹脂からなる複数のインナービアを有し、且つ前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあることを特徴とする部品内蔵モジュール。

【請求項２】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に電気絶縁層と複数の配線パターンとを備えた部品内蔵モジュールであって、前記コア層の電気絶縁材が少なくとも無機質フィラーと熱硬化性樹脂を含む混合物から形成され、前記コア層の内部に少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、前記コア層が複数の配線パターンと導電性樹脂からなる複数のインナービアを有し、前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあり、且つ前記熱硬化性樹脂が複数のガラス転移温度を有する熱硬化性樹脂からなることを特徴とする部品内蔵モジュール。

【請求項３】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に電気絶縁層と複数の配線パターンとを備えた部品内蔵モジュールであって、前記コア層の電気絶縁材が少なくとも無機質フィラーと熱硬化性樹脂を含む混合物から形成され、前記コア層の内部に少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、前記コア層が複数の配線パターンと導電性樹脂からなる複数のインナービアを有し、前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあり、且つ前記熱硬化性樹脂が少なくとも－２０℃から６０℃の範囲のガラス転移温度を有する熱硬化性樹脂と、７０℃から１７０℃の範囲のガラス転移温度を有する熱硬化性樹脂からなることを特徴とする部品内蔵モジュール。

【請求項４】　請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層、前記電気絶縁層及び前記配線パターンのすべてを貫通するスルーホールが形成されている部品内蔵モジュール。

【請求項５】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に無機質フィラーと熱硬化性樹脂を含む混合物から形成された電気絶縁材からなる電気絶縁層と、銅箔よりなる複数の配線パターンとを備えた請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記配線パターンが前記インナービアにより電気接続されている部品内蔵モジュール。

【請求項６】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に熱硬化性樹脂から形成された電気絶縁材からなる電気絶縁層と、銅メッキよりなる複数の配線パターンとを備えた請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記銅メッキよりなる配線パターンが前記インナービアにより電気接続されている部品内蔵モジュール。

【請求項７】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に熱硬化性樹脂が両面に形成された有機フィルムからなる電気絶縁層と、銅箔よりなる複数の配線パターンとを備えた請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記配線パターンが前記インナービアにより電気接続されている部品内蔵モジュール。

【請求項８】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に複数の配線パターンとインナービアを有するセラミック基板が接着された請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有している部品内蔵モジュール。

【請求項９】　電気絶縁材からなるコア層と、前記コア層の少なくとも片面に複数の配線パターンとインナービアを有する複数のセラミック基板が接着された請求項１～３のいずれかに記載の部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記複数のセラミック基板が異なる誘電率の誘電体材料よりなる部品内蔵モジュール。

【請求項１０】　前記コア層の少なくとも片面に形成された前記配線パターンの間に膜状受動部品を配置した請求項１～３のいずれかに記載の部品内蔵モジュール。

【請求項１１】　前記膜状受動部品が、薄膜又は無機質フィラーと熱硬化性樹脂の混合物からなる抵抗、コンデンサ及びインダクタからなる群から選ばれた少なくとも１つである請求項１０に記載の部品内蔵モジュール。

【請求項１２】　前記膜状受動部品が、少なくともアルミニウム又はタンタルの酸化層と導電性高分子よりなる固体電解コンデンサである請求項１０に記載の部品内蔵モジュール。

【請求項１３】　少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹

脂を充填し、銅箔上に能動部品及び／又は受動部品を実装し、前記部品実装済みの銅箔の部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記受動部品及び／又は能動部品を前記シート状物に埋没させて加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の銅箔を加工して配線パターンを形成させてコア層を作成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと前記銅箔とを位置合わせして重ねて加熱加圧することで一体化し、前記銅箔を加工して配線パターンを形成させることを特徴とする部品内蔵モジュールの製造方法。

【請求項１４】　前記コア層の上に位置合わせして重ねる銅箔において、予め前記銅箔の上に膜状部品が形成されている請求項１３に記載の部品内蔵モジュールの製造方法。

【請求項１５】　少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、前記受動部品及び／又は能動部品を前記シート状物に埋没一体化させて更に加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の離型キャリアを剥離してコア層を形成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと、片面に配線パターンを形成した離型キャリアとを位置合わせして重ねて加熱加圧することで一体化し、前記離型キャリアを剥離することを特徴とする部品内蔵モジュールの製造方法。

【請求項１６】　前記コア層の上に位置合わせして重ねる配線パターンを形成した前記離型キャリアにおいて、予め前記離型キャリアに形成された配線パターンの上に膜状部品が形成されている請求項１５に記載の部品内蔵モジュールの製造方法。

【請求項１７】　前記膜状部品が、薄膜又は無機質フィラーと熱硬化性樹脂の混合物からなる抵抗、コンデンサ及びインダクタからなる群から選ばれた少なくとも１つであり、且つ前記膜状部品が、蒸着法、ＭＯ－ＣＶＤ法又は厚膜印刷法のいずれかの方法で形成されている請求項１４又は１６に記載の部品内蔵モジュールの製造方法。

【請求項１８】　少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、銅箔上に能動部品及び／又は受動部品を実装し、前記部品実装済みの銅箔の部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記受動部品及び／又は能動部品を前記シート状物に埋没させて加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の銅箔を加工して配線パターンを形成させてコア層を作成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に、前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと前記銅箔とを位置合わせして重ねて加熱加圧硬化した後、コア層も含めて貫通孔を形成し、銅メッキにより貫通スルーホールを形成することを特徴とする部品内蔵モジュールの製造方法。

【請求項１９】　少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、前記受動部品及び／又は能動部品を前記シート状物に埋没一体化させて更に加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の離型キャリアを剥離してコア層を形成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に、前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと、片面に配線パターンを形成した離型キャリアとを位置合わせして重ねて加熱加圧硬化した後、コア層も含めて貫通孔を形成し、銅メッキにより貫通スルーホールを形成することを特徴とする部品内蔵モジュールの製造方法。

【請求項２０】　少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び

／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記熱硬化性樹脂が硬化しない温度域で加熱加圧し、前記受動部品及び／又は能動部品を前記シート状物に埋没させ一体化させてコア層を形成し、前記コア層より前記離型キャリアを剥離し、前記剥離済みのコア層の少なくとも片面にインナービアと配線パターンを少なくとも２層以上形成したセラミック基板を重ねて加圧して、前記コア層中の熱硬化性樹脂を硬化させて前記セラミック基板と接着させることを特徴とする部品内蔵モジュールの製造方法。

【請求項２１】　前記複数の配線パターンとインナービアを有するセラミック基板が、コア層と接着層を介して複数枚同時に積層される請求項２０に記載の部品内蔵モジュールの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、半導体などの能動部品や抵抗、コンデンサなどの受動部品を内蔵した高密度実装モジュールに関するものである。

【０００２】

【従来の技術】近年、電子機器の高性能化、小型化の要求に伴い、半導体の高密度、高機能化が一層叫ばれている。これによりそれらを実装するため回路基板もまた小型高密度なものが望まれている。これらの要求に対し、高密度実装を実現する手段として、ＬＳＩ間や部品間の電気配線を最短距離で接続できる基板の層間の電気接続方式であるインナビアホール接続法が、最も回路の高密度配線化が図れることから各方面で開発が進められている。

【０００３】しかしながら、これらの方法によっても２次元的に部品を高密度に実装することは限界に近づきつつある。また、これらのインナービア構造の高密度実装基板は、樹脂系の材料で構成されているため、熱伝導度が低く、部品実装が高密度になればなる程部品から発生する熱を放熱させることは困難となる。近々には、ＣＰＵのクロック周波数が１ＧＨｚ程度になるといわれており、またその機能の高度化とあいまってＣＰＵの消費電力も１チップ当たり１００～１５０Ｗに達しようとする予測もある。また、高速化、高密度化に伴いノイズの影響も避けて通れなくなりつつある。従って、回路基板は高密度、高機能に加え、対ノイズ、放熱性に加え、部品を内蔵した３次元実装形態のモジュールの出現が期待されている。

【０００４】このような要求に対し、特開平２－１２１３９２号公報には、多層セラミック基板を応用し、内部にコンデンサや抵抗体を形成したモジュールが提案されている。このようなセラミック多層基板は、基板材料と同時焼成可能な高誘電体材料をシート状に加工し、内部に挟み込んで焼成することで得られるが、異種の材料を同時焼成する場合、焼結タイミングのずれや、焼結時の収縮率の違いにより、焼成後にそりが生じたり内部の配線に剥離が生じたりすることがあり、精密な焼成条件のコントロールが必要である。また、セラミック基板による部品内蔵は、先に示した通り同時焼成が基本であるため、コンデンサや抵抗体などは形成できるが、耐熱性に欠けるシリコンなどの半導体を同時焼成することは不可能であり内蔵することはできない。

【０００５】一方、低温で半導体などの能動部品やコンデンサ、抵抗などの受動部品を内蔵させた回路基板の提案がなされている。特開平３－６９１９１号公報、特開平１１－１０３１４７号公報には、プリント基板材に形成された銅配線に電子部品を搭載し、更にその上に樹脂で一面に被覆して埋め込み層を形成し、更に接着剤で複数層接着する方法が記載されている。また、特開平９－２１４０９２号公報には、貫通のスルーホール内に誘電体などの材料を埋設し、表面電極を形成してコンデンサや抵抗を内蔵する方法が記載されている。加えて、プリント基板自体にコンデンサなどの機能を付加させる方法もある。特開平５－７０６３号公報（特許第３０１９５４１号）には、誘電体粉末と樹脂を混合した誘電体基板の両面に電極を形成したコンデンサ内蔵基板が記載されている。また、特開平１１－２２０２６２号公報には、インナービア構成で半導体やコンデンサなどを内蔵させる方法が記載されている。

【０００６】

【発明が解決しようとする課題】このように従来の高密度配線が可能なインナービア構造を有し、且つ部品を内蔵した３次元実装モジュールは、放熱性と気密性に優れたセラミック基板を応用したものと、低温で硬化させることができるプリント基板によるものがある。セラミック基板では、放熱性に優れ、高い誘電率のコンデンサを内蔵できる反面、異種の材料を同時に焼成させることが難しく、また半導体を内蔵させることができないことやコスト面でも課題を有している。一方、低温で硬化が行なえるプリント基板では、半導体を内蔵させることができる可能性がありコスト的にも有利であるが、誘電体材料などと樹脂を混合した複合材料では、高い誘電率を得ることは難しい。このことは前述のスルーホール内に形成したコンデンサや誘電体粉末を混合したプリント基板の例を見ても明らかである。また、一般的にプリント基板は熱伝導度が低く放熱性には難がある。また、プリント基板に実装した半導体やコンデンサなどを樹脂で封止して複数積層内蔵させる方法についても、個別部品を内蔵することができる反面、個別部品を埋設するためモジュール自体の厚みが厚くなり、モジュール体積を小さくすることが困難である。また、内蔵部品とプリント基板の熱膨張係数差による熱ストレスに対し、内蔵部品とプリント基板材料の間に特定の熱膨張係数を有する緩衝層

を形成することや、プリント基板材料の熱膨張係数を合わせるなどの手段が取られるが、半導体の熱膨張係数は一般に小さく、プリント基板材料だけで熱膨張係数を動作温度域にわたって合致させることは極めて難しい。

【０００７】そこで、本発明は前記従来の問題を解決するため、熱硬化性樹脂に無機質フィラーを高濃度に充填することが可能で、しかも簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設させ、且つ多層配線構造を簡易に作製することができる熱伝導性部品内蔵モジュールを提供することを目的とする。本発明では、無機質フィラーと熱硬化性樹脂を選択することで、所望の性能を有するモジュールの作製が可能であり、しかも放熱性に優れ、誘電特性にも優れた超高密度な実装形態を有する部品内蔵モジュールを提供できる。

【０００８】

【課題を解決するための手段】前記目的を達成するため、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に電気絶縁層と複数の配線パターンとを備えた部品内蔵モジュールであって、前記コア層の電気絶縁材が少なくとも無機質フィラーと熱硬化性樹脂を含む混合物から形成され、前記コア層の内部に少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、前記コア層が複数の配線パターンと導電性樹脂からなる複数のインナービアを有し、且つ前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあることを特徴とする。

【０００９】これにより、簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設でき、任意の無機質フィラーと熱硬化性樹脂を選択することで、所望の性能を有し、かつ熱衝撃などのストレスに対しても高い信頼性を有するモジュールが提供可能である。即ち、モジュールの平面方向の熱膨脹係数を半導体と合わせたり、放熱性を持たせることができる。加えて、電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲とすることで半導体などの部品をストレスなく内蔵できるので超高密度な実装形態を有するモジュールが実現できる。また、部品を内蔵したコア層の表面には再配線が可能な多層高密度配線層が形成できるので、薄く極めて高密度なモジュールが実現できる。更に、今後の高周波化の進展によるノイズの問題も半導体とチップコンデンサの配置を極力近くできるので、ノイズ低減の効果も期待できる。

【００１０】また、本発明の部品内蔵モジュールは、前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあり、且つ前記熱硬化性樹脂が複数のガラス転移温度を有する熱硬化性樹脂から構成されることにより、さまざまな熱膨張係数を有する部品が内蔵されても内蔵部品の熱衝撃からの熱ストレスに強い部品内蔵モジュールが得られる。

【００１１】また、本発明の部品内蔵モジュールは、前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲にあり、且つ前記熱硬化性樹脂が少なくとも－２０℃から６０℃の範囲のガラス転移温度を有する熱硬化性樹脂と、７０℃から１７０℃の範囲のガラス転移温度を有する熱硬化性樹脂からなることを特徴とする。これにより、さまざまな熱膨張係数を有する部品が内蔵されても内蔵部品の熱衝撃からの熱ストレスに更に強い部品内蔵モジュールが得られる。

【００１２】また、本発明の部品内蔵モジュールは、前記コア層、前記電気絶縁層及び前記配線パターンのすべてを貫通するスルーホールが形成されていることが好ましい。

【００１３】これにより、前記に加えて通常のプリント基板作製プロセス、設備がそのまま利用できるので、極めて簡易に部品内蔵モジュールが実現できる。

【００１４】また、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に無機質フィラーと熱硬化性樹脂を含む混合物から形成された電気絶縁材からなる電気絶縁層と、銅箔よりなる複数の配線パターンとを備えた前記部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記配線パターンが前記インナービアにより電気接続されていることが好ましい。

【００１５】これにより、簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設でき、且つ表層配線層にも任意の無機質フィラーを選択することで、所望の性能を有するモジュールが可能である。即ち、モジュールの平面方向の熱膨脹係数を半導体と合わせたり、放熱性を持たせることができる。また、部品を内蔵したコア層の表面には再配線が可能な多層高密度配線層がインナービア構成で形成できるので、薄く極めて高密度なモジュールが実現できる。

【００１６】また、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に熱硬化性樹脂から形成された電気絶縁材からなる電気絶縁層と、銅メッキよりなる複数の配線パターンとを備えた前記部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記銅メッキよりなる配線パターンが前記インナービアにより電気接続されていることが好ましい。

【００１７】これにより、上記に加え既存のメッキ技術をそのまま利用することができ、しかも表層配線や絶縁層を薄く形成できるので、より薄い部品内蔵高密度モジュールが実現できる。

【００１８】また、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に熱硬化性樹脂が両面に形成された有機フィルムからなる電気絶縁層と、銅箔よりなる複数の配線パターンとを備えた前記部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記配線パターンが前記インナービアにより電気接続されていることが好ましい。

【００１９】これにより、高密度で薄い表層配線層が形成できるだけでなく、有機フィルムにより極めて表面平滑性に優れる。また、同様に厚み精度に優れるため、表層配線のインピーダンス制御が極めて高精度に行なえ、高い周波数帯域に適合した高周波用の部品内蔵モジュールが実現できる。

【００２０】また、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に複数の配線パターンとインナービアを有するセラミック基板が接着された前記部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有していることが好ましい。

【００２１】これにより、部品が内蔵され、且つ放熱性や気密性に優れ、高い誘電率のコンデンサを内蔵したモジュールが得られる。

【００２２】また、本発明の部品内蔵モジュールは、電気絶縁材からなるコア層と、前記コア層の少なくとも片面に複数の配線パターンとインナービアを有する複数のセラミック基板が接着された前記部品内蔵モジュールであって、前記コア層が複数の銅箔よりなる配線パターンと導電性樹脂からなる複数のインナービアを有し、前記複数のセラミック基板が異なる誘電率の誘電体材料よりなることが好ましい。

【００２３】これにより、高い誘電率のセラミックコンデンサと高速回路に適した誘電率の低いセラミック基板の異種積層が容易に実現できる。特に、高速配線層には伝送損失の小さいセラミック層を利用し、バイパスコンデンサが必要な部分には高い誘電率のセラミック層を利用することができる。

【００２４】また、本発明の部品内蔵モジュールは、前記コア層の少なくとも片面に形成された前記配線パターンの間に膜状受動部品を配置することが望ましい。これにより、更に高密度に部品を内蔵した３次元モジュールが実現できる。

【００２５】また、本発明の部品内蔵モジュールは、前記膜状受動部品が、薄膜又は無機質フィラーと熱硬化性樹脂の混合物からなる抵抗、コンデンサ及びインダクタからなる群から選ばれた少なくとも１つであることが望ましい。薄膜では優れた性能の受動部品が得られるからである。また、無機質フィラーと熱硬化性樹脂からなる膜状部品は製造が容易であり、信頼性にも優れるからである。

【００２６】また、本発明の部品内蔵モジュールは、前記膜状受動部品が、少なくともアルミニウム又はタンタルの酸化層と導電性高分子よりなる固体電解コンデンサであることが望ましい。

【００２７】また、本発明の部品内蔵モジュールの製造方法は、少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、銅箔上に能動部品及び／又は受動部品を実装し、前記部品実装済みの銅箔の部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記受動部品及び／又は能動部品を前記シート状物に埋没させて加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の銅箔を加工して配線パターンを形成させてコア層を作成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと前記銅箔とを位置合わせして重ねて加熱加圧することで一体化し、前記銅箔を加工して配線パターンを形成させることを特徴とする。

【００２８】この方法により、簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設でき、且つ外層部にも部品を更に実装できるので、極めて高密度で小型のモジュールが実現できる。また、コア表層部にも配線パターンを形成できるので、更に高密度なモジュールとなる。更に、表層部の材料を選択できるので熱伝導や誘電率、熱膨張などを制御できる。

【００２９】また、本発明の部品内蔵モジュールの製造方法は、前記コア層の上に位置合わせして重ねる銅箔において、予め前記銅箔の上に膜状部品が形成されていることが好ましい。

【００３０】また、本発明の部品内蔵モジュールの製造方法は、少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、前記受動部品及び／又は能動部品を前記シート状物に埋没一体化させて更に加熱加圧することにより、前記シート

状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の離型キャリアを剥離してコア層を形成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと、片面に配線パターンを形成した離型キャリアとを位置合わせして重ねて加熱加圧することで一体化し、前記離型キャリアを剥離することを特徴とする。

【００３１】この方法により、簡易な工法で半導体などの能動部品やチップ抵抗、チップコンデンサなどの受動部品を内部に埋設でき、且つ外層部にも部品を更に実装できるので、極めて高密度で小型のモジュールが実現できる。更に、表層部の配線パターンの形成を転写により行なえるので、硬化工程の後にエッチングなどの処理が不要となり、工業上簡易な方法となる。

【００３２】また、本発明の部品内蔵モジュールの製造方法は、前記コア層の上に位置合わせして重ねる配線パターンを形成した前記離型キャリアにおいて、予め前記離型キャリアに形成された配線パターンの上に膜状部品が形成されていることが好ましい。

【００３３】また、本発明の部品内蔵モジュールの製造方法は、前記膜状部品が、薄膜又は無機質フィラーと熱硬化性樹脂の混合物からなる抵抗、コンデンサ及びインダクタからなる群から選ばれた少なくとも１つであり、且つ前記膜状部品が、蒸着法、ＭＯ－ＣＶＤ法又は厚膜印刷法のいずれかの方法で形成されていることが好ましい。

【００３４】また、本発明の部品内蔵モジュールの製造方法は、少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、銅箔上に能動部品及び／又は受動部品を実装し、前記部品実装済みの銅箔の部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記受動部品及び／又は能動部品を前記シート状物に埋没させて加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の銅箔を加工して配線パターンを形成させてコア層を作成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に、前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと前記銅箔とを位置合わせして重ねて加熱加圧硬化した後、コア層も含めて貫通孔を形成し、銅メッキにより貫通スルーホールを形成することを特徴とする。

【００３５】これにより、部品を内蔵したコア層を基本として、従来の貫通スルーホール技術をそのまま利用することがでるので、工業上極めて有効である。

【００３６】また、本発明の部品内蔵モジュールの製造方法は、少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、前記受動部品及び／又は能動部品を前記シート状物に埋没一体化させて更に加熱加圧することにより、前記シート状物中の熱硬化性樹脂及び導電性樹脂を硬化させ、その後前記最外層部の離型キャリアを剥離してコア層を形成し、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記コア層の少なくとも片面に、前記貫通孔に導電性樹脂を充填した混合物シート又は有機フィルムと、片面に配線パターンを形成した離型キャリアとを位置合わせして重ねて加熱加圧硬化した後、コア層も含めて貫通孔を形成し、銅メッキにより貫通スルーホールを形成することを特徴とする。

【００３７】これにより、部品を内蔵したコア層を基本として、従来の貫通スルーホール技術をそのまま利用することがでるので、工業上極めて有効である。

【００３８】また、本発明の部品内蔵モジュールの製造方法は、少なくとも無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填し、離型キャリアの片面に配線パターンを形成し、前記離型キャリアの配線パターン上に能動部品及び／又は受動部品を実装し、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記熱硬化性樹脂が硬化しない温度域で加熱加圧し、前記受動部品及び／又は能動部品を前記シート状物に埋没させ一体化させてコア層を形成し、前記コア層より前記離型キャリアを剥離し、前記剥離済みのコア層の少なくとも片面にインナービアと配線パターンを少なくとも２層以上形成したセラミック基板を重ねて加圧して、前記コア層中の熱硬化性樹脂を硬化させて前記セラミック基板と接着させることを特徴とする。

【００３９】この方法により、上記同様極めて高密度で小型のモジュールが実現できる。また、種々の性能にすぐれたセラミック基板を一体化できるので、更に高性能なモジュールが実現できる。

【００４０】また、本発明の部品内蔵モジュールの製造方法は、前記複数の配線パターンとインナービアを有す

るセラミック基板が、コア層と接着層を介して複数枚同時に積層されることが望ましい。これにより特に、異種のセラミック基板を同時に積層できるので、極めて簡易な製法が実現できる。

【００４１】

【発明の実施の形態】本発明はその第１の態様として、未硬化状態の熱硬化性樹脂に高濃度に無機質フィラーを添加した混合物からなる電気絶縁性基板の内部に、１つ以上の能動部品及び／又は受動部品を内蔵し、複数の配線パターンと、それら配線パターンの間を電気的に接続する導電性樹脂からなるインナービアを有するコア層の少なくとも片面に、電気絶縁層と配線パターンが複数層形成された部品内蔵モジュールを提供するものである。本モジュールは、受動部品や能動部品を内蔵し、しかも配線パターンの間を導電性樹脂によるインナービアで接続するもので、且つ部品を内蔵したコア層上に配線パターンを多層構成で形成したもので、きわめて高密度な実装形態を実現することができる。また、無機質フィラーの選択で、平面方向の熱膨張係数が半導体とほぼ同じで、しかも高熱伝導性を付与することが可能である。また、本モジュールは、１つ以上の能動部品及び／又は受動部品を内蔵した前記コア層の少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材の室温に於ける弾性率が０．６～１０ＧＰａの範囲とすること、および前記熱硬化性樹脂が複数のガラス転移温度を有する熱硬化性樹脂から構成することにより、さまざまな熱膨張係数を有する部品が内蔵されても内蔵部品の熱衝撃からのストレスに強い部品内蔵モジュールが得られる。

【００４２】本発明の部品内蔵モジュールは、熱硬化性樹脂に無機質フィラーを添加させた混合物であり、セラミック基板のように高温で焼成する必要がなく、２００℃程度の低温で加熱することで得られる。また、従来の樹脂基板に比べ、無機質フィラーを添加しているので、熱膨張係数、熱伝導度、誘電率などを任意に制御することができるという格別の効果がある。なお、コア層と多層配線層を貫通するスルーホール構成としても良い。これにより、極めて層間の接続抵抗の低い部品内蔵モジュールが形成でき、部品を内蔵した超小型電源モジュールに最適である。同様にコア層上に形成された多層状の形成された電気絶縁層に無機質フィラーと熱硬化性樹脂の混合物を用いた場合、コア層と同様、熱膨張率、熱伝導度、誘電率を制御することが可能となる。

【００４３】また、第２の態様は、少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材に、少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、且つ複数の銅箔よりなる配線パターンと複数の導電性樹脂よりなるインナービアを有するコア層の少なくとも片面に配線パターンとインナービアを有するセラミック基板が接着された構造である部品内蔵モジュールを提供するものである。これにより、部品を高密度に内蔵するとともにセラミック基板の持つ種々の性能を併せ持つことができる。即ち、セラミック基板は高密度配線が可能であるばかりか、誘電率を３から１００００程度の大きさで制御でき、熱伝導度も大きいものが得られる。このような性能をそのまま利用できるという格別の効果がある。更に、前記した特定の弾性率、ガラス転移温度範囲の熱硬化性樹脂を用いることにより、異種の性能、物性を有するセラミック基板であってもストレス無く積層することができ、且つ熱衝撃などのストレスに対してもクラックが生じない高い信頼性を有するモジュールが実現できる。

【００４４】また、第３の態様は、少なくとも無機質フィラーと熱硬化性樹脂を含む混合物からなる電気絶縁材に、少なくとも１つ以上の能動部品及び／又は受動部品を内蔵し、且つ複数の配線パターンと複数の導電性樹脂よりなるインナービアを有するコア層の少なくとも片面に電気絶縁層と配線パターンが複数層形成され、且つ前記コア層上に形成された前記配線パターン間に膜状能動部品が形成された構造の部品内蔵モジュールを提供するものである。これにより、部品を高密度に内蔵するとともにコア層上に形成された配線層にも膜状の部品が形成できるので、極めて実装密度の高い部品内蔵モジュールが実現できる。膜状部品は、コア層上に形成した配線パターンを取り出して電極とする抵抗体やコンデンサ、インダクタであり、配線パターンに抵抗体やコンデンサを厚膜印刷法や蒸着法で任意の形状に形成することができる。

【００４５】また、第４の態様は、部品内蔵モジュールの製造方法に関するものである。即ち、無機質フィラーと未硬化状態の熱硬化性樹脂の混合物をシート状に加工し、貫通孔を形成して導電性樹脂を充填したシート状物を準備し、銅箔上に能動部品や受動部品を実装したものと前記シート状物を位置合わせして重ね、更に銅箔を重ねて前記受動部品や能動部品を前記シート状物に埋没させ、且つ硬化させてコア層を形成し、更に前記最外層部の銅箔を加工して配線パターンを形成する。次に、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物シート又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記貫通孔に導電性樹脂を充填したものと前記コア層の銅箔とを位置合わせして重ねて加熱加圧することで一体化し、更に銅箔を加工して配線パターンを形成する。

【００４６】また、第５の態様は、部品内蔵モジュールの製造方法に関するものである。即ち、無機質フィラーと未硬化状態の熱硬化性樹脂からなる混合物をシート状に加工し、前記無機質フィラーと未硬化状態の熱硬化性樹脂からなるシート状物に貫通孔を形成し、前記貫通孔に導電性樹脂を充填する。一方、離型キャリアの片面に配線パターンを形成し、この配線パターン上に能動部品

及び／又は受動部品を実装する。次いで、前記部品実装済みの配線パターンを有する前記離型キャリアの部品実装面に前記貫通孔に導電性樹脂を充填したシート状物を位置合わせして重ね、更に銅箔を重ねて前記熱硬化性樹脂が硬化しない温度域で加熱加圧して前記受動部品及び／又は能動部品を前記シート状物に埋没させ一体化させてコア層を形成する。更に、前記コア層より前記離型キャリアを剥離し、前記剥離済みコア層の少なくとも片面にインナービアと配線パターンを少なくとも２層以上形成したセラミック基板を重ねて加圧して、前記コア層中の熱硬化性樹脂を硬化させて前記セラミック基板と接着させる。

【００４７】上記実施の態様において、セラミック基板は高誘電率の積層コンデンサであってもよいし、また２種類のセラミック材料よりなる基板を同時に接着形成してもよい。高誘電率のセラミックコンデンサと低誘電率の高速回路用セラミック基板を部品が内蔵されたコア層に接着することで、高周波用部品内蔵モジュールが得られる。

【００４８】次に、本発明の部品内蔵モジュール及びその製造方法のより具体的な態様を図面に基づき説明する。

【００４９】図１は、本発明の部品内蔵モジュールの構成を示す断面図である。図１において、１００はコア層１０５に形成された配線パターンであり、１０１はその配線パターン１００上に実装された能動部品である半導体のベアチップである。また、１０４は同様に配線パターン１００上に実装された受動部品であるチップ部品であり、１０２は無機質フィラーと熱硬化性樹脂の複合されたコンポジット材料からなる電気絶縁層である。１０３はコア層１０５に形成された配線パターン１００の間を電気的に接続するインナービアである。更に、１０６はコア層１０５の上に形成された電気絶縁層であり、１０８、１０７はそれぞれ最上層の配線パターンとインナービアである。図１のように、半導体１０１やチップ部品１０４を内蔵し、且つ表面の配線パターン１０８の上には更に部品を実装することが可能であるため、極めて高密度な実装モジュールとなる。

【００５０】前記熱硬化性樹脂としては、例えばエポキシ樹脂、フェノール樹脂及びシアネート樹脂を挙げることができる。このとき前記熱硬化性樹脂の室温に於ける弾性率、ガラス転移温度を制御する方法として、それぞれの樹脂組成に対して室温で低弾性率もしくはガラス転移温度が低い樹脂を添加する方法が挙げられる。また、前記無機質フィラーとしては、Al_2O_3、MgO、BN、AlN、SiO_2等を挙げることができる。また、必要であれば、無機質フィラーと熱硬化性樹脂の複合物に、更にカップリング剤、分散剤、着色剤、離型剤を添加することも可能である。

【００５１】図２は、本発明の部品内蔵モジュールの別の構成を示す断面図である。図２において、２０９はコア層２０５及びコア層の上に形成された配線層を貫通するように形成された貫通スルーホールである。貫通スルーホール２０９により、コア層２０５とコア層の両面に形成された配線パターン２０８を電気的に接続することができる。これにより、大電流を必要とする電源モジュールなどに応用することができる。なお、貫通スルーホール２０９は、ドリルやレーザー加工により穴あけ加工を行ない、電解銅めっき法により貫通孔の壁面に導電層を形成し、更にフォトリソ法と化学エッチング法で配線パターンを形成することができる。

【００５２】図３は、本発明の部品内蔵モジュールの別の構成を示す断面図である。図３において、３０５はコア層３０４の上に形成された電気絶縁層であり、３０６はその電気絶縁層３０５の上に形成された配線パターンである。電気絶縁層３０５は感光性の絶縁樹脂が利用でき、フィルム状の樹脂をラミネートすることや、液状の感光性樹脂をコータなどにより塗布しても形成できる。例えば、膜状に形成された感光性樹脂をフォトリソ法によりインナービア３０７を加工して開口させ、更に無電解銅メッキ、電解銅メッキにより配線層を形成し、更に既存のフォトリソ法で配線パターン３０６を形成することで電気絶縁層３０５が得られる。なお、この工程を繰り返し行なうことで、多層構造の配線層が得られ、電気絶縁層３０５に形成した開口部を利用してインナービア３０７が形成できる。また、無電解銅メッキ前に前記電気絶縁層を粗化することで銅の配線パターン３０６の接着強度を強くすることが可能である。

【００５３】図４は、本発明の部品内蔵モジュールの別の構成を示す断面図である。図４は図１と同様に、半導体４０１を内蔵したコア層４０４の上に形成した配線パターン４０７とインナービア４０６、電気絶縁層４０５を有している。更に、コア層４０４の上に形成された配線パターン４０７を取り出して電極とする膜状部品が形成されている。４０９は抵抗体を表す膜状部品、４０８はコンデンサを表す膜状部品である。このように部品を内蔵したコア層４０４の上に更に膜状部品４０８、４０９が形成された極めて高密度な部品内蔵モジュールとすることができる。

【００５４】図５は、本発明の部品内蔵モジュールの別の構成を示す断面図である。図５は図１と同様に、半導体５０１を内蔵したコア層５０５と、焼結型のインナービア５０８と配線パターン５０７、セラミック材料層５０６を同時焼成して得られた多層セラミック基板５０９とを、電気接続するためのインナービア５１１を有するシート状物５１０で接着した構成であり、更に同様にセラミック基板５０９の下部に形成されたインナービア５１３を有するシート状物５１２と配線パターン５１４を有している。上記配線パターン５１４の上には、半田ボール５１５が形成されており、高密度な部品内蔵モジュ

ールが得られる。このように高密度配線が可能で、種々の性能を有するセラミック基板と一体化することで、更に高機能な部品内蔵モジュールが得られる。

【００５５】図６（ａ）～（ｈ）は、前記部品内蔵モジュールの製造工程を示す断面図である。図６（ａ）において、６０２は前記のような無機質フィラーと未硬化状態の熱硬化性樹脂の混合物をシート状に加工したものに貫通孔を形成し、更にインナービア６０３に導電性ペーストを充填したシート状物である。シート状物６０２の加工は、無機質フィラーと液状の熱硬化性樹脂を混合してペースト状混練物を作製するか、無機質フィラーに溶剤で低粘度化した熱硬化性樹脂を混合して同様にペースト状混練物を作製する。次に、ペースト状混練物を一定厚みに成型し、熱処理することでシート状物６０２を得る。

【００５６】熱処理は、液状樹脂を用いたものでは粘着性があるため、若干硬化を進めて未硬化状態で可撓性を維持しながら粘着性を除去するために行う。また、溶剤により樹脂を溶解させた混練物では、前述の溶剤を除去し、同様に未硬化の状態で可撓性を保持しながら粘着性を除去する。このようにして作製された未硬化状態のシート状物６０２に形成する貫通孔は、レーザー加工法や金型による加工、又はパンチング加工で行なうことができる。特に、レーザー加工法では、炭酸ガスレーザーやエキシマレーザーが加工速度の点で有効である。導電性ペーストは、金や銀、銅の粉末を導電材料とし、これにシート状物６０２と同様の熱硬化性樹脂を混練したものが使用できる。特に、銅は導電性が良好で、マイグレーションも少ないため有効である。また、熱硬化性樹脂も液状のエポキシ樹脂が耐熱性の面で安定である。

【００５７】図６（ｂ）は、銅箔６００に能動部品である半導体６０１やチップ部品６０４を実装した状態を示している。この時、半導体６０１は、導電性接着剤を介して銅箔６００と電気的に接続されている。銅箔６００は、電解メッキにより作製された１８μｍから３５μｍ程度の厚さのものが使用できる。特に、シート状物６０２との接着性を改善するため、シート状物６０２との接触面を粗化した銅箔が望ましい。また、同様に接着性、酸化の防止のため、銅箔表面をカップリング処理したものや錫、亜鉛、ニッケルメッキしたものも使用できる。半導体６０１のフリップチップ実装用導電性接着剤は、同様に金、銀、銅、銀ーパラジウム合金などを熱硬化性樹脂で混練したものが使用できる。また、導電性接着剤の代わりに半田によるバンプ、又は金ワイヤボンディング法で作製したバンプを半導体側にあらかじめ形成し、熱処理による半田の溶解を利用して半導体６０１を実装することも可能である。また、半田バンプと導電性接着剤の併用もまた可能である。

【００５８】次に、図６（ｃ）において、６００は別途用意した銅箔であり、上記した方法で作製したシート状物６０２と半導体６０１、チップ部品６０４を実装した銅箔６００を図のように位置合わせして重ねた状態を示している。

【００５９】次に、図６（ｄ）は、位置合わせして重ねたものをプレスにより、加熱加圧して半導体６０１及びチップ部品６０４を前記シート状物６０２に埋設、一体化した状態を示している。この時の部品の埋設は、前記シート状物６０２の中の熱硬化性樹脂が硬化する前の状態で行ない、更に加熱して硬化させ、前記シート状物６０２の熱硬化性樹脂及び導電性樹脂の熱硬化性樹脂を完全に硬化させる。これにより、シート状物６０２と半導体６０１、チップ部品６０４、及び銅箔６００が機械的に強固に接着する。また、同様に導電性ペーストの硬化により銅箔６００の間の電気的接続が行なわれる。次に、図６（ｅ）に示すように、熱硬化性樹脂が硬化し、半導体６０１が埋設、一体化された基板の表面の銅箔を加工して配線パターン６００とし、コア層６０５が作製される。図６（ｆ）は、作製したコア層６０５を基本として、無機質フィラーと未硬化状態の熱硬化性樹脂の混合物からなるシート状物６０６又は両面に接着層を形成した有機フィルムに貫通孔を形成し、前記貫通孔に導電性ペーストを充填したものを、コア層６０５の両面に位置合わせして重ね、更に銅箔６０８を重ねたものである。これを加熱加圧することで図６（ｇ）のように、コア層６０５の両面に配線層が形成できる。次いで、図６（ｈ）のように、接着した銅箔６０８を化学エッチング法で配線パターン６０９が形成できる。これにより部品を内蔵した部品内蔵モジュールが実現できる。その後、半田による部品実装や、絶縁樹脂の充填などの工程があるが、ここでは本質ではないので省略している。

【００６０】図７（ａ）～（ｉ）は、図６と同様に作製されるシート状物７０４を用いて作製される部品内蔵モジュールの製造方法を示した断面図である。図７（ａ）では、離型キャリア７００の上に、配線パターン７０１と配線パターン７０１を取り出して電極とする膜状部品７１１が形成されている。離型キャリア７００は、配線パターン７０１及び膜状部品７１１を転写後、離型されてしまうものであり、ポリエチレンやポリエチレンテレフタレートなどの有機フィルムや、銅などの金属箔が使用できる。配線パターン７０１は、離型キャリア７００に銅箔などの金属箔を接着剤を介して接着させたものや、金属箔上に更に電解メッキ法などで形成することができる。このように膜状に形成した金属層を化学エッチング法などの既存の加工技術を利用して配線パターン７０１が形成できる。図７（ｂ）は、離型キャリア７００の上に形成した配線パターン７０１に半導体７０２やチップ部品７０３を実装した状態を示している。また、図７（ｃ）は、図６のようにして作製されたシート状物７０４を示し、図７（ｄ）では、図６と同様の方法で貫通孔を加工し導電性ペーストをインナービア７０５に充填

した状態を示している。図7（ｅ）では、このようにして作製された導電性ペーストを充填したインナービア７０５を形成したシート状物７０４を中心にし、配線パターン７０１を形成した離型キャリア７００と、同じく離型キャリア７００の上に実装した部品を有する離型キャリア７００を位置合わせして重ねた状態を示している。これを加熱加圧し、前記シート状物７０４の中の熱硬化性樹脂を硬化させて離型キャリア７００を剥離した状態を示したのが図7（ｆ）である。この加熱加圧工程により、半導体７０２及びチップ部品７０３を前記シート状物７０４に埋設、一体化した状態となる。この時の半導体７０２とチップ部品７０３の埋設は、前記シート状物７０４中の熱硬化性樹脂が硬化する前の状態で行ない、更に加熱して硬化させ、前記シート状物７０４の熱硬化性樹脂及び導電性ペーストの熱硬化性樹脂を完全に硬化させる。これにより、シート状物７０４と半導体７０２、及び配線パターン７０１が機械的に強固に接着する。また、同様にインナービア７０５の導電性ペーストの硬化により配線パターン７０１の電気的接続が行なわれる。この時、あらかじめ離型キャリア７００の上の配線パターン７０１の厚みにより、前記シート状物７０４は更に圧縮され、配線パターン７０１もシート状物７０４に埋設される。これにより配線パターンとモジュール表面は平滑な状態の部品内蔵コア層７０６が形成できる。

【００６１】次に、図7（ｇ）は、このようにして作製された部品内蔵のコア層７０６を中心として、図7（ｄ）のようにして作製されたシート状物７０７と膜状部品７１１を形成した離型キャリア７１０を位置合わせして重ね、加熱加圧することで、図7（ｈ）のような多層モジュールが作製できる。最後に図7（ｉ）のように離型キャリア７１０を剥離することにより、本発明の多層モジュールが完成する。このように半導体やチップ部品を内蔵したコア層と、配線パターンと膜状部品を形成した離型キャリアを用いることで、更に高密度で且つ種々の機能を内蔵した部品内蔵モジュールが得られる。

【００６２】図8（ａ）～（ｄ）は、多層セラミック基板と積層して得られる部品内蔵モジュールの製造方法を示す断面図である。図8（ａ）は、図6（ｅ）で示した部品を内蔵したコア層８０５を示す。次いで、図8（ｂ）は、このコア層８０５と多層セラミック基板８０９を用いて、インナービア８１１を形成したシート状物８１０と、同様にインナービア８１３を形成したシート状物８１２を図のように位置合わせして重ね、且つ銅箔８１４を更に重ねた状態を示している。次に、図8（ｃ）に示すように、この積層体を加熱加圧することで、前記シート状物８１０と８１２の中の熱硬化性樹脂が硬化し、コア層８０５と多層セラミック基板８０９及び銅箔８１４が機械的に強固に接着する。そして、図8（ｄ）に示すように、最後に銅箔８１４を加工して配線パターンとし、半田ボール８１５を設けることにより、多層セラミックと部品内蔵コア層とが一体化された部品内蔵モジュールが完成する。なお、多層セラミック配線基板は、ガラスとアルミナを主成分とする低温焼成基板材料よりなるグリーンシートを用いて作製される。即ち、９００℃程度で焼成できるセラミック材料によるグリーンシートに貫通孔を形成し、この貫通孔に銅又は銀などの高導電性の粉体よりなる導電性ペーストを充填し、更に配線パターンを同様の導電性ペーストで印刷することで形成し、このようにして作製した複数のグリーンシートを積層し、更に焼成することで得られる。このようにして作製されるセラミック基板材料は、目的に応じチタン酸バリウムを主成分とする高誘電率材料や窒化アルミニウムなどを主成分とする高熱伝導材料などを用いてもよく、またセラミック積層体の最外層の配線パターンは形成しても良いし、インナービア形成だけを行ない配線パターンを形成しなくとも良い。また、図8（ａ）～（ｄ）では、１枚のセラミック基板を用いたが、前記種々の種類のセラミック材料よりなる基板を同時に複数枚シート状物で積層して形成しても良い。

【００６３】

【実施例】以下、実施例に基づき本発明を詳細に説明する。

【００６４】（実施例１）本発明の部品内蔵モジュールの作製に際し、先ず無機質フィラーと熱硬化性樹脂によるシート状物の作製方法から述べる。本実施例に使用したシート状物を作製するには、先ず無機質フィラーと液状の熱硬化性樹脂を撹拌混合機により混合する。使用した撹拌混合機は、所定の容量の容器に無機質フィラーと熱硬化性樹脂、必要に応じて粘度調整のための溶剤を投入し、容器自身を回転させながら公転させるもので、比較的粘度が高くても充分な分散状態が得られるものである。実施した部品内蔵モジュール用のシート状物の配合組成を表１及び表２に示す。

【００６５】

【表１】

	硬化性樹脂の組成					
	硬化性樹脂1			硬化性樹脂2		
	内容	質量%	Tg(℃)	内容	質量%	Tg(℃)
例1	エポキシ樹脂(旭チバ製"6041")	10	75	−	−	−
例2	エポキシ樹脂(日本ペルノックス製"WE-2025")	5	80	エポキシ樹脂(旭チバ製"6018")	5	130
例3	エポキシ樹脂(油化シェル・エポキシ製"エピキュア YH-306")	10	110	−	−	−
比較例	エポキシ樹脂(旭チバ製"6099")	10	178	−	−	−

【0066】
【表2】

	無機質フィラーの組成		室温弾性率(GPa)
	内容	充填%	
例1	アルミナ粉、平均粒径12μm(昭和電工製"AS-40")	90	0.72
例2	アルミナ粉、平均粒径12μm(昭和電工製"AS-40")	90	7.6
例3	アルミナ粉、平均粒径12μm(昭和電工製"AS-40")	90	7.7
比較例	アルミナ粉、平均粒径12μm(昭和電工製"AS-40")	90	36.5

【0067】具体的作製方法は、上記組成で秤量・混合されたペースト状の混合物の所定量を取り、離型フィルム上に滴下させる。混合条件は、所定量の無機質フィラーと前記エポキシ樹脂を容器に投入し、本容器ごと混練機によって混合した。混練機は、容器を公転させながら、自転させる方法により行われるもので、10分程度の短時間で混練が行なわれる。また、離型フィルムとして厚み75μmの表面にシリコンによる離型処理を施されたポリエチレンテレフタレートフィルムを用いた。滴下させた離型フィルム上の混合物に更に離型フィルムを重ね、加圧プレスで一定厚みになるようにプレスした。次に、片面の離型フィルムを剥離させ、混合物を離型フィルムごと加熱し、溶剤を除去して粘着性が無くなる条件下で熱処理した。熱処理条件は、温度が120℃で15分間保持である。これにより前記混合物は、厚み500μmの粘着性のないシート状物となる。前記熱硬化性エポキシ樹脂は、硬化開始温度が130℃であるため、前記熱処理条件下では未硬化状態(Bステージ)であり、以降の工程で加熱により再度溶融させることができる。

【0068】このようにして作製したシート状物の物性を評価するため熱プレスを行い、シート状混合物の硬化物を作成し、硬化物の弾性率、ガラス転移温度を測定した。熱プレスの条件は、作成したシート状物を離型フィルムで挟み、200℃で2時間、4.9MPaの圧力で熱プレスして行った。硬化物の室温における弾性率とガラス転移点(Tg)を表1及び表2に、弾性率の温度特性を図9にそれぞれ示す。硬化物の室温に於ける弾性率は、表1及び表2に示すとおり、約0.7GPa程度から約8GPa程度であり、比較例として36.5GPaのエポキシ樹脂を用いたものも準備した。また、例2のようにガラス転移温度が異なるエポキシ樹脂を混合したものについても評価を行った。なお、ガラス転移温度は、図10に示すように弾性率E'の温度特性に基づく弾性率の粘性挙動を示すTanδから求めたものである。図10は、例2の弾性率E'の温度特性を示したもので、Tanδの変曲点からこの混合物のガラス転移点がそれぞれ50℃、130℃であることが判る。

【0069】以上のような物性を有する未硬化状態のシート状物を所定の大きさにカットし、炭酸ガスレーザーを用いてピッチが0.2mm～2mmの等間隔の位置に直径0.15mmの貫通孔を形成した。この貫通孔に、ビアホール充填用導電性ペーストとして、平均粒径2μmの球形状の銅粒子85質量%と、樹脂組成としてビスフェノールA型エポキシ樹脂(油化シェルエポキシ製"エピコート828")3質量%とグルシジルエステル系エポキシ樹脂(東都化成製"YD-171")9質量%と、硬化剤としてアミンアダクト硬化剤(味の素製"MY-24")3質量%とを三本ロールにて混練したものを、スクリーン印刷法により充填した(図6(a)参照)。次に、35μmの片面を粗化した銅箔600に半導体601及びチップ部品604を、銀粉とエポキシ樹脂からなる導電性接着剤によりフリップチップ実装を行なう。このようにして作製した半導体を実装した銅箔600と、別途準備した片面粗化処理した厚さ35μmの銅箔600をシート状物に位置合わせして挟む。この時、銅箔の粗化面は シート状物側になるよう配置した。次いで、熱プレスを用いてプレス温度120℃、圧力0.98MPaで5分間加熱加圧する。これにより、前記シート状物602の中の熱硬化性樹脂が加熱により溶融軟化するため、半導体601、チップ部品604がシート状物の中に埋没する。更に、加熱温度を上昇させ175℃で60分間保持した。これによりシート状物中のエポキシ樹脂及び、導電性樹脂中のエポキシ樹脂が硬化し、シート状物と半導体及び銅箔が機械的に強固に接着し、且つ導電性ペーストが前記銅箔と電気的(インナービア接続)、機械的に接着したコア層605が得られる。この半導体を埋設したコア層605の表面の銅箔をエッチング技術によりエッチングして、インナービアホ

ール上に直径0．2mmの電極パターン及び配線パターン600が形成される。

【0070】このようにして作製されたコア層605を用いて多層化を行なう。使用したシート状物は、厚さ25μmのアラミドフィルム（旭化成製“アラミカ”）の両面に接着剤としてのエポキシ樹脂（日本レック製“EF-450”）を5μmの厚みまで塗布したものに、炭酸ガスレーザー加工機を用いて穴加工を行なった。加工した穴径は100μmで、これに上記導電性ペーストを充填したものを用いた（図6（f）参照）。このようにして作製した有機フィルムに接着層を形成したシート状物を前記コア層605の両面に位置合わせして重ね、更に、片面粗化処理した厚さ18μmの銅箔608を重ねて加熱加圧した。そして、最上層の銅箔608をパターン形成し、部品内蔵モジュールを得た。

【0071】本方法によって作製された部品内蔵モジュールの信頼性評価として、吸湿リフロー試験、熱衝撃試験（温度サイクル試験）を行なった。吸湿リフロー試験は、温度85℃、湿度85%の条件下で168時間保持した部品内蔵モジュールを、最高温度が240℃で20秒間ベルト式リフロー試験機に1回通すことで行なった。また、熱衝撃試験は、高温側が125℃、低温側が-40℃の温度で各30分間保持し、1000サイクル行なった。

【0072】各試験後の評価として、部品内蔵コア内に形成したインナービア接続（100個のインナービアを直列に接続）の抵抗値が±10%以内であれば良品とし、断線や10%以上接続抵抗が上昇したものを不良とした。また、内蔵部品の評価基準としては、内蔵した部品の接合面の断線及び部品性能の劣化がないものを良品とし、内蔵部品の電気接続がインナービアと同様に±10%以上変化したもの、もしくは部品性能が変化したもの不良とした。この時、半導体モジュールは形状的にもクラックが発生せず、超音波探傷装置でも特に異常は認められなかった。なお、内蔵部品としては、チップ抵抗（20個）、チップコンデンサ（20個）、テスト用半導体（1チップ：接続端子数30）を用いた。その信頼性評価の結果を表3に示す。

【0073】

【表3】

	弾性率 (GPa)	ガラス転移点 Tg(℃)	信頼性評価項目			
			熱衝撃試験 (不良数/試験数)		吸湿リフロー試験 (不良数/試験数)	
			ビア接続信頼性	内蔵部品信頼性	ビア接続信頼性	内蔵部品信頼性
例1	0.72	/5	0/100	0/70	2/100	1/70
例2	7.6	50/130	0/100	0/70	0/100	0/70
例3	7.7	110	1/100	0/70	0/100	0/70
比較例	36.5	178	12/100	25/70	9/100	34/70

【0074】表3から明らかなように室温に於ける弾性率が0．6Gpa以上、10GPa以下の範囲であれば良好な信頼性が得られるのがわかる。特に比較例では、室温の弾性率が高いため、熱衝撃時の応力ストレスによりインナービア接続や内蔵部品の劣化が目立つ。これはそれぞれの熱膨張係数の差によって生じる応力に対して弾性率が高いと高ストレスとなり、応力が集中する部品接続部が断線するためと思われる。また、比較例ではガラス転移温度が高いため、弾性率が高温でも高いことによるものと思われる。それに比べ、例1から例3では、比較的高い信頼性が得られる。特に弾性率の異なる2つの種類のエポキシ樹脂を用いた例2では、室温の弾性率がそれほど低くなくても、温度の上昇と共に弾性率が大きく低下するため（図10参照）、高い信頼性を保持できるものと考えられる。また、最も室温の弾性率が低い例1の電気絶縁材料では、熱衝撃試験については良好な性能を有するものの、吸湿状態でのリフロー試験ではやや信頼性が劣る。これは実使用上問題のない程度の信頼性であるが、これ以上弾性率が低いものは吸湿が大きくなるため吸湿リフロー試験では問題となる。従って、更に良好な信頼性を得るには、例2のように複数の弾性率、ガラス転移温度を有するエポキシ樹脂を用いると良いことは明らかである。

【0075】これにより、半導体とモジュールは強固な密着が得られていることがわかる。また、導電性ペーストによるインナービア接続抵抗もコア層、配線層ともにほとんどが初期性能と変化がなかった。

【0076】（実施例2）実施例1の例2と同様のシート状物を用いて半導体を内蔵させたモジュールの実施例を示す。

【0077】実施例1と同一条件で作製した貫通孔に導電性ペーストを充填した厚さ500μmのシート状物704を準備した（図7（d）参照）。次に、厚さ70μmの銅箔を離型キャリアとし、更に9μmの厚みの銅を電解銅メッキ法で離型キャリア上に形成した。この離型キャリアを用いて、配線パターンを形成する。9μmの厚みの銅を形成した離型キャリアをフォトリソ法により化学エッチングし、図7（a）に示した配線パターン701を形成する。このようにして作製した配線パターン付離型キャリアに、半導体及びチップ部品を半田バンプによりフリップチップ実装を行なった。更に、別の配線パターンを有する離型キャリア上に膜状部品を印刷によ

り形成した。膜状部品７１１は、熱硬化性樹脂にカーボン粉末を混合した抵抗体ペーストである。印刷は、既存のスクリーン印刷法により行なった。

【００７８】このようにして作製した半導体を実装した離型キャリアと、別途準備した配線パターンだけを有する離型キャリアを前記導電性ペーストを充填したシート状物７０４に位置合わせして挟む。この時、配線パターンは シート状物側になるよう配置した。これを熱プレスを用いてプレス温度１２０℃、圧力０．９８ＭＰａで５分間加熱加圧する。これにより、前記シート状物７０４の中の熱硬化性樹脂が加熱により溶融軟化するため、半導体７０２及びチップ部品７０３がシート状物中に埋没する。更に、加熱温度を上昇させて１７５℃で６０分間保持した。これによりシート状物中のエポキシ樹脂及び、導電性ペースト中のエポキシ樹脂が硬化し、シート状物と半導体及び配線パターンが機械的に強固に接着する。更に、導電性ペーストが前記配線パターン７０１と電気的（インナービア接続）、機械的に接着する。次に、この半導体を埋設した硬化物の表面の離型キャリアを剥離した。離型キャリアは光沢面を有し、且つ電解メッキにて配線層を形成してあるため、離型キャリアである銅箔だけを剥離させることができる。この状態で部品が内蔵されたコア層７０６が形成できた。次いで、このコア層７０６を用いて、更に配線層を形成する。本方法では、あらかじめ配線パターンを形成した離型キャリアを用いるため、硬化後のモジュールは配線パターンもモジュール内に埋め込まれた平坦なコア層となる。これにより、コア層表面に微細な多層配線が形成できることになる。また、同様に配線パターンが埋設されることにより、表面の配線パターンの厚み分だけシート状物が圧縮される。よって、信頼性が良好な導電性ペーストの電気的接続が得られる。

【００７９】次いで、半導体及びチップ部品を内蔵した本コア層を用いて更に多層配線層を形成する。上記コア層の両面に実施例１で作製した導電性ペーストを充填した厚さ１００μｍのシート状物を用い、更に膜状部品７１１を形成した配線パターン７０１を有する離型キャリア７００を用いて図７（ｇ）のように挟み込む。これを上記と同様の条件で加熱加圧し、硬化させてコア層及び離型キャリアの上の配線パターン７０１及び膜状部品７１１を一体化させる。更に、硬化後に離型キャリア７１０を剥離することで本発明の部品内蔵モジュールが得られる。このように離型キャリアを用いることで、基板作製時に化学エッチングなどの湿式工程が必要なくなり、簡易に微細な配線パターンが得られる。また、有機フィルムを用いた離型キャリアでは、部品を内蔵する前に実装性能を評価できるので、離型キャリア上で不良な部品を修理できるという格別の効果もある。

【００８０】本方法によって作製された部品内蔵モジュールの信頼性評価として、吸湿リフロー試験、熱衝撃試験（温度サイクル試験）を行なった。吸湿リフロー試験、熱衝撃試験は実施例１と同様の条件下で行なった。この時半導体モジュールは形状的にもクラックが発生せず、超音波探傷装置でも特に異常は認められなかった。これにより、半導体とモジュールは強固な密着が得られていることがわかる。また、導電性ペーストによるインナービア接続抵抗、内蔵部品接続及び部品性能もほとんど初期性能と変化がなかった。

【００８１】（実施例３）実施例１の例２と同様のシート状物を用いて半導体を内蔵させたコア層と多層セラミック基板を用いて更に高密度なモジュールを作製する実施例を示す。

【００８２】実施例１と同一条件で作製した半導体８０２を内蔵したコア層８０５を用いた（図８（ａ）参照）。コア層の厚みは３００μｍである。次に、多層セラミック基板８０９と前記コア層８０５を接着層により積層を行なう。なお、セラミック多層配線基板は、ガラスとアルミナを主成分とする低温焼成基板材料よりなる厚さ２２０μｍのグリーンシート（日本電気硝子製“ＭＬＳ－１０００”）を用いて作製される。即ち、多層配線基板は、本グリーンシートに貫通孔としてパンチャにより直径０．２ｍｍの穴加工を行ない、この貫通孔に平均粒径２μｍの銀粉体を主成分とし、エチルセルロース樹脂とターピネオール溶剤を混合した導電性ペーストを充填し、更に配線パターンを同様の導電性ペーストで印刷することで形成し、このようにして作製した複数のグリーンシートを７０℃の温度で４．９ＭＰａの圧力で積層し、更に９００℃で１時間で焼成することで作製した。

【００８３】次に、実施例１のように作製したシート状物に貫通孔を形成し、更に導電性ペーストを充填した厚み１００μｍのシート状物８１０及び８１２を準備し、前記コア層８０５と多層セラミック基板８０９を図８（ｂ）のように位置合わせして重ね、加熱加圧して一体化したモジュールを作製する。この時、最下層のシート状物には銅箔８１４を重ねて一体化しても良いし、図７（ａ）のように膜状部品を形成した離型キャリアを用いて配線パターンを転写してもよい。なお、このようにして形成されたモジュールの配線パターンに半田ボールを実装し、接続端子とすることができる。

【００８４】本方法によって作製された部品内蔵モジュールの信頼性評価として、実施例１と同様の吸湿リフロー試験、熱衝撃試験（温度サイクル試験）を行なった。この時、半導体モジュールはセラミック基板と積層された複合モジュールでありながら、形状的にもクラックが発生せず、超音波探傷装置でも特に異常は認められなかった。これにより、半導体とモジュールは強固な密着が得られていることがわかる。

【００８５】また、モジュールの耐衝撃性を評価するため、１．８ｍの高さから落下させる落下強度を評価し

た。具体的には、完成したモジュールをガラスエポキシ基板の上に半田付けで実装し、アルミニウム製容器にセットしてコンクリート上に落下させ、モジュールが破損しないか調べた。比較例として作製した前記セラミック基板だけの場合は、半数にクラックが生じたが、実施例3のモジュールではクラックの発生はなかった。このことからも、前記シート状物で接着したものは、セラミック基板だけでは得られない応力緩和層としての働きがあると考えられ、本発明の格別の効果といえる。

【００８６】また、導電性ペーストによるインナービア接続抵抗もほとんど初期性能と変化がなかった。

【００８７】

【発明の効果】以上説明したように、本発明の部品内蔵モジュールによれば、熱硬化性絶縁樹脂と高濃度の無機質フィラーの混合物によるシート状物を用いることで、能動部品及び／又は受動部品を内部に埋設することができ、しかもその少なくとも片面に配線パターンと電気絶縁層による多層配線が同時に形成できるので、極めて高密度なモジュールが実現できる。また、無機質フィラーを選定することで、熱伝導度、熱膨張係数、誘電率を制御することが可能である。このことは、平面方向の熱膨張係数を半導体とほぼ同じにすることが可能であり、半導体を直接実装する基板としても有効である。更に、熱伝導度を向上させることにより、放熱を必要とする半導体などを実装する基板としても有効である。加えて、誘電率を低くすることも可能で、高周波回路用として低い損失の基板にも有効である。加えて、熱硬化性樹脂の室温での弾性率、ガラス転移温度を特定の範囲にすることで熱衝撃試験などの熱ストレスに対し高い信頼性を有する部品内蔵モジュールが実現できる。

【００８８】また、本発明の部品内蔵モジュールの製造方法によれば、無機質フィラーと未硬化状態の熱硬化性樹脂を含む混合物をシート状物に加工して貫通孔を形成し、導電性樹脂を充填したシート状物を準備し、離型キャリアの片面に配線パターンを形成した上に能動部品や受動部品を実装したものと、前記シート状物を位置合わせして重ね、更に別途作製した前記離型キャリア上に配線パターンを有する離型キャリアの配線パターン面を内側にして重ね、前記シート状物に埋没一体化させて加熱加圧により硬化させることで本発明の部品内蔵モジュールが得られる。更に、この時離型キャリア上に形成した配線パターンを取り出して電極とする膜状部品も同時に形成できる。これにより、能動部品や受動部品を内蔵した極めて高密度なモジュールが簡易な方法で実現できるとともに、配線パターンも前記シート状物に埋設できるため、表面が平滑なモジュールが実現できる。これにより、本発明のモジュールの表面に配線パターンの段差がないため、更に高密度に部品を実装することができる。

【００８９】また、本発明の多層構造を有する部品内蔵モジュールの製造方法は、半導体などの能動部品とチップ抵抗などの受動部品を内蔵できるだけでなく、多層セラミック基板も同時に内層に形成できるため、極めて高密度なモジュールが実現できる。また、種々の性能を有するセラミック基板を複数同時に積層できるので、極めて高機能なモジュールが実現できる。

【００９０】以上のように本発明は、能動部品や受動部品をモジュールに内蔵でき、且つ配線パターンの間をインナービアで接続できるので、極めて高密度なモジュールが簡易な方法で実現できる。

【図面の簡単な説明】

【図１】本発明の一実施例による多層構造を有する部品内蔵モジュールの断面図である。

【図２】本発明の一実施例による多層構造を有する部品内蔵モジュールの断面図である。

【図３】本発明の一実施例による多層構造を有する部品内蔵モジュールの断面図である。

【図４】本発明の一実施例による多層構造を有する部品内蔵モジュールの断面図である。

【図５】本発明の一実施例による多層構造を有する部品内蔵モジュールの断面図である。

【図６】本発明の一実施例による多層構造を有する部品内蔵モジュールの製造工程を示す断面図である。

【図７】本発明の一実施例による多層構造を有する部品内蔵モジュールの製造工程を示す断面図である。

【図８】本発明の一実施例による多層構造を有する部品内蔵モジュールの製造工程を示す断面図である。

【図９】部品内蔵モジュールの電気絶縁材料の弾性率の温度特性を示した図である。

【図１０】本発明の部品内蔵モジュールの一実施例である電気絶縁材料の弾性率E'とTanδを示した図である。

【符号の説明】

１００、１０８、２００、２０８、３００、３０６、４００、４０７、５００、５０４、５０７、５１４、６０９、７０１、７０９，８０１、８０７　配線パターン

１０１、２０１、３０１、４０１、５０１、６０１、７０２、８０２　半導体

１０２、１０６、２０２、２０６、３０２、３０５、４０２、４０５、５０２、８０３　電気絶縁層

１０３、１０７、２０７、３０３、３０７、４０３、４０６、５０３、５０８、５１１、５１３、６０３、６０７、７０５、７０８、８０４、８０８、８１１、８１３　インナービア

１０４、２０４、６０４、７０３、　チップ部品

１０５、２０５、３０４、４０４、５０５、６０５、７０６、８０５　コア層

２０９　貫通スルーホール

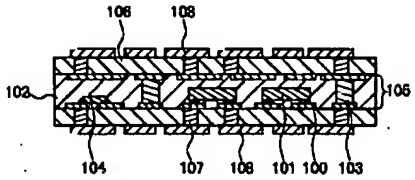
４０８　コンデンサ

４０９　抵抗体

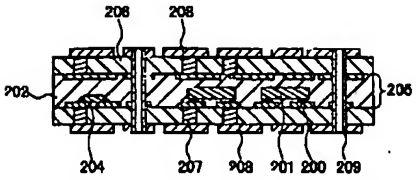
５０６、８０６　セラミック材料層

509、809　多層セラミック基板
510、512、602、606、704、707、810、812　シート状物
515、815　半田ボール
600、608、814　銅箔
700、710　離型キャリア
711　膜状部品

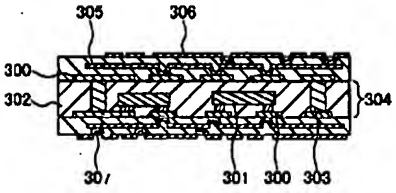
【図1】



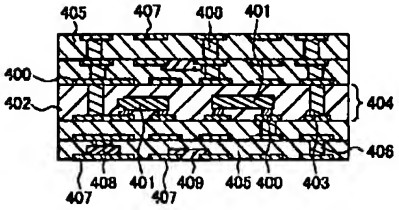
【図2】



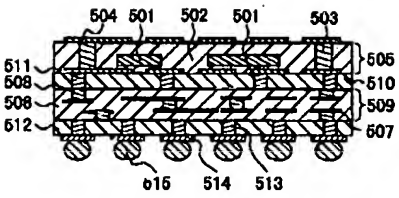
【図3】



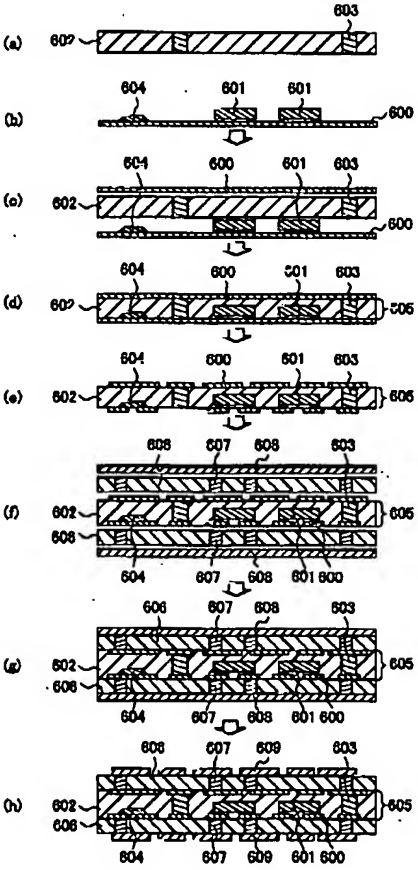
【図4】



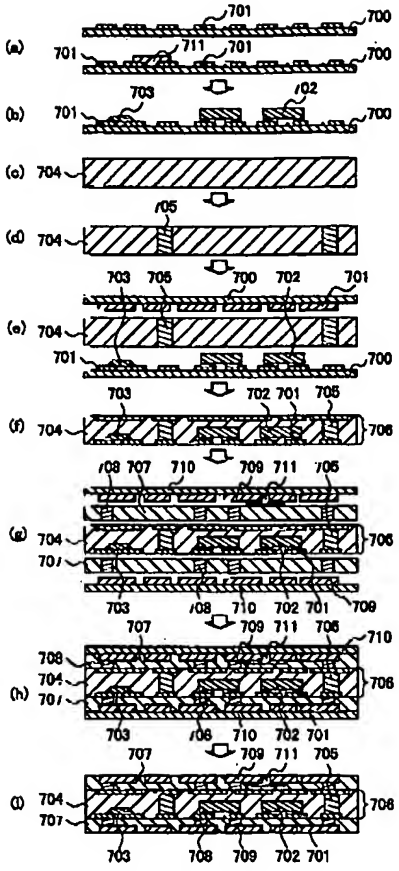
【図5】



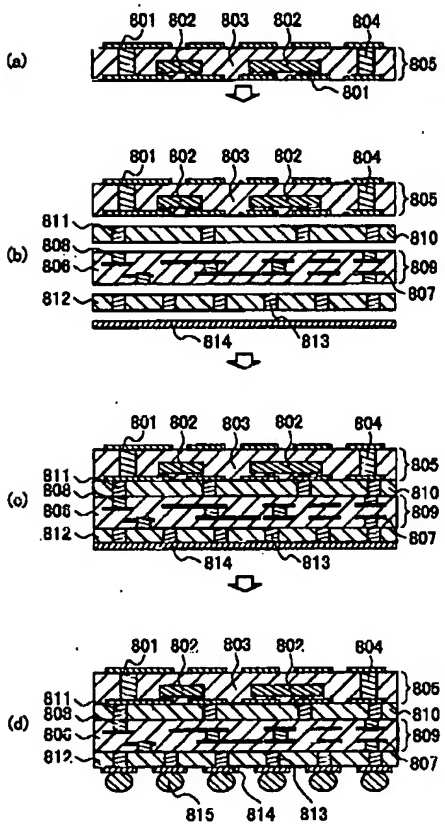
【図6】



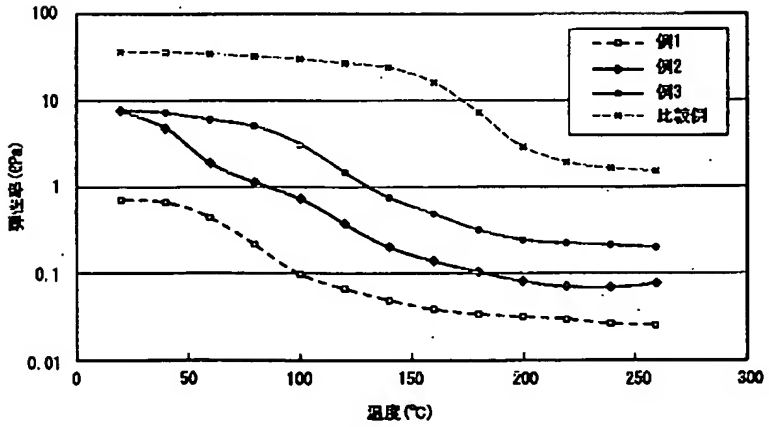
【図7】



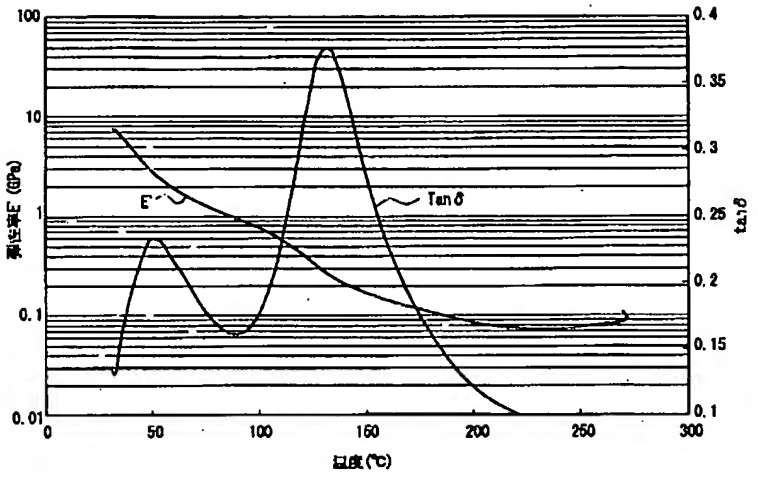
【図8】



【図9】



【図10】



フロントページの続き

(51)Int.Cl.[7]	識別記号	FI		(参考)
H01L	23/12	H05K	1/11	N
	23/14		1/18	R
	25/04		3/40	K
	25/18	H01L	23/12	B
H05K	1/11		23/14	R
	1/18		25/04	Z
	3/40			

(72)発明者 朝日 俊行
大阪府門真市大字門真1006番地 松下電器産業株式会社内
(72)発明者 小松 慎五
大阪府門真市大字門真1006番地 松下電器産業株式会社内

Fターム(参考) 5E317 AA24 BB01 BB12 CC22 CC25 CD32 CD34 GG16
5E336 AA08 BB03 BB15 BC26 BC34 CC31 CC51 CC55 GG03 GG14
5E346 AA04 AA12 AA15 AA32 AA35 AA43 AA60 BB01 CC02 CC08 CC32 DD02 DD12 DD32 EE02 EE06 EE09 EE13 EE19 EE41 FF18 FF35 FF45 GG22 GG27 GG28 GG40 HH11 HH17 HH33